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TO OUR READERS

In this issue of the International College of Surgeons' *Journal,* we are honoring the natal anniversary of two of America's foremost surgeons, Doctors Raymond W. McNealy and Karl A. Meyer of Chicago. These men are active in the teaching and practice of their profession, and whatever is said of them today may be observed in their respective hospitals and teaching centers.

It is fitting that the Editor of the International College of Surgeons' *Journal* has elected to dedicate this issue to them jointly since they are devoted personal and professional friends. Both teach in Northwestern University and both are connected with the great Cook County Hospital. It is a pleasure and an inspiration to attend their clinics and to see the precise and masterly execution of the most intricate surgical procedures.

They both enjoy the distinction and recognition by membership in The American College of Surgeons, The International College of Surgeons, The American Board of Surgery, the Western Surgical Association and numerous other medical and surgical societies.

We salute them both as stalwart leaders of the surgical profession, great clinical teachers and true friends of the medical and surgical profession everywhere. May their successful work in surgery continue ad multos annos.

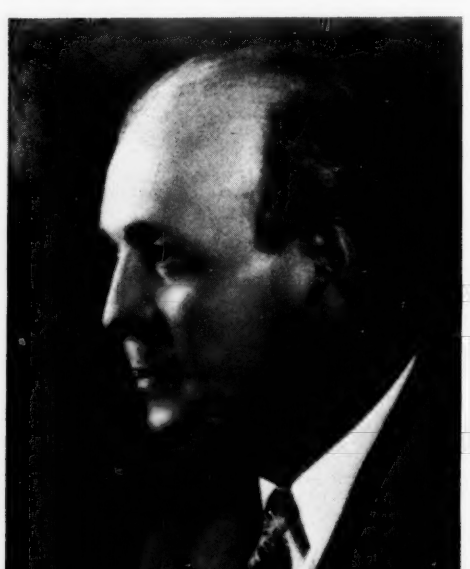
HERBERT ACUFF
President-Elect,
International College of Surgeons

Dr. Karl A. Meyer

Dr. Meyer was born September 28, 1886, in Gilmore, Illinois. He graduated from the University of Illinois, College of Medicine, in 1908, served his internship at Cook County Hospital from 1908 to 1910. He became Medical Superintendent of Cook County Hospital in 1914, in which capacity he still serves. He is Attending Surgeon at the Cook County Hospital, Professor of Surgery at Cook County Hospital Graduate School of Medicine, Professor of Surgery at Northwestern University School of Medicine, Chief Surgeon of Grant Hospital, a Trustee of the University of Illinois, and formerly Professor of Clinical Surgery at the University of Illinois (1920–1925). He is Honorary Fellow of the International College of Surgeons and Chairman of the Board of Trustees of its United States Chapter; Fellow of the American College of Surgeons, Past-President of the Chicago Surgical Society. He is a prolific contributor to the surgical literature and a surgeon of note.

Dr. Raymond W. McNealy

Born in 1886, Dr. McNealy graduated from the University of Illinois College of Medicine in 1910, interned at Cook County Hospital to 1912 and took postgraduate work in Vienna in 1913. He is Attending Surgeon and President of Staff, Cook County Hospital; Chief Surgeon of Wesley Memorial Hospital; Associate Professor of Surgery at Northwestern University Medical School; Professor of Surgery, Cook County Graduate School of Medicine; member of the Public Health Advisers of the Department of Public Health, State of Illinois, and Secretary-Treasurer, Hektoen Institute. He is Chairman of the Qualification Board of the International College of Surgeons and his memberships in scientific societies and contributions to surgical literature are too numerous to mention.



Both of these outstanding surgeons were born in the same year, served their internships in the same institution, are now occupying similar positions in the education of young surgeons. Not only has their collaboration and cooperation been unusually successful, but also palpably entwined.

Original Articles

Observations on Surgery and Surgeons in Europe

HERBERT ACUFF, M.D., D.Sc., F.A.C.S., F.I.C.S.
KNOXVILLE, TENNESSEE

ON our recent visit to Italy and other countries in Europe on the occasion of the Sixth Biennial Assembly of the International College of Surgeons, it occurred to me that so very much of the fundamental knowledge of anatomy, medicine and surgery came from these countries that one should take time out and walk in the footsteps of some of these masters and look back in retrospect to the days when they actually lived and worked.

ITALY

Italy was the first country visited, and Rome was the first city. Both Italy and Rome are so replete historically in so many phases of our living that one is intrigued with the environment from the moment one arrives. From my days in the study of history I remember that the earliest hospital foundation in the West, according to St. Jerome, was that of Faviola at Rome about the end of the fourth century. Faviola herself, being a practical nurse as well as a great organizer, instituted the system of visiting the sick in connection with hospital work. This was the forerunner of the present day visiting nurse. She did a great deal of charity and there was no distinction of creed or race in her ministrations. The great and noble work of this woman deeply influenced the people all over Europe.

As one pursues his travels and studies in and about Rome and other parts of Italy, the great array of old masters and discoverers in the various phases of anatomy and medicine passes in review. We think with fitting tribute and respect of Marcello Malpighi who lived between 1628 and 1694, his great contribution in the discovery of the capillaries in the lungs, and his work in connection with the red corpuscles of the blood, the minute structure of the kidneys and spleen as well as his masterly demonstration of the rete Malpighi of the skin and structure of the teeth, which have become basic concepts in all subsequent study in those respective fields. We recall of course the malpighian bodies, the structure of the tongue, his demonstration that papillae of the tongue are organs of the sense of taste and that the papillae of the skin are organs of the sense of touch.

He was a great scientist, a student, and became the Papal physician to Pope Innocent XII, remaining in this position for three years prior to his death in 1694 at the age of sixty-six.

We think of Antonio Pacchioni whose greatest contribution to medicine and surgery was perhaps in his studies of the anatomy of the meninges and brain. More recently we think of Duranti who introduced the osteoplastic bone flap in brain surgery. We think of Bassini whose name is an operating room byword in practically every hospital in the land. It was he who perfected the technic of herniorrhaphy and, strange to say, few if any improvements on his procedure have stood the test of time.

We think of Antonio Carle and his excellent contributions to the surgery of the thyroid and gastrointestinal tract. While he lived in Turin, his teachings and methods were emulated by surgeons of all Italy. He died in 1927. We revere the memory and great contributions to surgery of Mario Donati and Ottorino Uffreduzzi whose brilliant careers were cut all too short by their untimely death.

The work of the International College of Surgeons was carried on and all scientific sessions held at the Policlinico Hospital, Numero 1, Umberto Avenue in Rome. This is a large, rambling type of building with

an imposing front and particularly impressive at the central entrance or main building where the wide staircases ascend to the second and third floors in circular fashion. The surgical amphitheaters are rather modern with good equipment and the surgeons all appear to be well trained and dexterous in the execution of surgical procedures.

It was indeed wonderful and refreshing for me to meet again Professor Raffaele Bastianelli, under whom I had the opportunity of spending a few days in review of plastic surgery and treatment of bone and joint injuries in World War I. Professor Bastianelli at the age of eighty-three still operates, conducts his regular clinics and is adored and respected by surgeons not only of Rome but of Italy and of the world. He is truly one of the great characters of medicine, and his work in abdominal surgery and rehabilitation surgery will pass into history as most valuable contributions.

Professor Bastianelli was Honorary Chairman of the Committee on Arrangements for the Assembly, and was present at practically all of the sessions. His wife is a very charming American woman, formerly of Pittsburgh, Pennsylvania, and he too speaks perfect English. Not only was he generous with his presence at all of the scientific sessions, but he also opened his home to various groups of surgeons for luncheon and dinner engagements, thus giving many of us a better opportunity to know him in a more personal way.

Professor Raffaele Paolucci was the active General Chairman of the Assembly, and he, together with Professor Giuseppe Bendandi acting as his Secretary, organized the work of the Assembly in a most admirable manner. The surgical clinics were put on early in the morning, starting at 7:30 a.m. in order that the operative procedures might in no sense interfere with the scientific sessions which began about 9:00 o'clock. There were various amphitheaters in the Policlinico where programs for different sections of the Assembly could be held simultaneously.

The general opening session in the Campidoglio or Town Hall was a most dignified and impressive ceremony, to say nothing of the generous refreshments and entertainment which followed. The building is situated on one of the highest hills of Rome. From the large open terrace one can see the Tiber as it winds through the city of Rome, St. Peter's with its majestic dome rising easily above surrounding buildings, the Vatican City and, looking in another direction, the historic Roman Forum, the Imperial Street leading from the beautiful Victor Emanuel II monument and Palazzo Venizia to the Colosseum of Flavius.

Professor Paolucci is not only a gifted and skillful surgeon but he is a thoroughly cultured and erudite author and speaker. He is forceful, dramatic and convincing. He worked unceasingly for the success of the Assembly, not only in the operating room where he performed many operations for the Assembly, but also in his participation in the program and in opening his own home to literally dozens of visiting surgeons. The untiring and detailed work done by Professor Bendandi was both efficient and successful.

It was an interesting observation to note the high percentage of partial and subtotal gastrectomies being performed for the various phases of peptic ulcer. Gastric resection in Italy is not of too long duration, the first for perforated ulcer having been successfully performed by Gandusio in Trieste in 1922. Since then the reported cases have multiplied though not without frequent disagreement among the various surgeons.

The teachings and practice of Allesandri popularized the operation of partial gastrectomy until now it is almost the accepted treatment for perforation, resistant ulcers and other conditions. The surgeons base their favorable results and therefore their plan of procedure upon the rather low mortality in all phases of ulcer disease, and all types of patients are taken into consideration. For instance, in a statistical analysis by the French surgeon Brocq of 1,220 partial gastrectomies in cases of perforated ulcers which he had collected from medical literature, the statement was made that 15 per cent mortality was noted in patients below the age of 45 and 25 per cent above this age, while in palliative surgery only the mortality was 20 per cent below the age of 45 and 43 per cent above the age of 45.

The last five or six years one of the larger

clinics there has collected a series of 5,000 partial gastric resections and another clinic has accumulated a series of 3,000 partial gastrectomies. The reason given for this rather radical number of gastric resections is the economic level of the patients since many cannot afford rehospitalization nor can they afford the indisposition with loss of work which might result from palliative measures.

There is a rather high incidence of tuberculosis in Italy and a considerable amount of excellent thoracic surgery is being done. It was an interesting observation that the greater portion of this thoracic surgery was done by general surgeons in the regular course of their operative work.

At present much greater stress is being laid upon the training of young surgeons in Italy than formerly. They are kept in formal training from three to five years, during which time they are permitted to assist as first and second assistants to the professors in charge, and afterward begin to work under the strictest surveillance.

I was very much impressed with the dignity with which the medical and surgical meetings were conducted, having had occasion to attend a meeting of the Societa Romana di Chirurgia in Rome. This meeting was presided over by Professor Raffaele Paolucci who is also President of this Society. The deliberations of the meeting were dignified, professional and quite impressive. Four of the Fellows of the International College of Surgeons were given Socio Honorario in this Society. This distinction is made all the more impressive, not only by the beautiful embossed certificate which is presented, but by the personalized medal bearing on the one side the name of the individual so honored, with the date, and on the opposite side the proverbial symbol of Romulus and Remus nursing the wolf.

One is impressed by the dignity that characterizes the various meetings and ceremonies which are held in Italy as compared with the informality of our own society meetings. The Assembly in Rome was from every standpoint an outstanding success. It is well nigh impossible to pay the proper tribute and thanks to the many men whose efforts were a contributing factor to the success of the Assembly. In addition to those who have been prominently mentioned the names of Doctors Valdoni, Parduini, Montenere, Tosati must also be cited for they will always remain as highlights in the success of this journey to Rome.

Being a firm believer in the value of the gastroscope in upper abdominal surgery, I was interested in the analysis of 260 cases of gastric disease reported by Dr. diNatale of Milano. He suggests two uses for the gastroscope: one, the determination of the lesion prior to operation and therefore the procedure to be carried out at operation; two, the endoscopic examination which may give information sufficient to make operation unnecessary. He strongly emphasizes the importance of collaborating with the radiologist.

Dr. Valdoni gave a beautiful presentation of 100 abdominal operative cases. Valdoni uses an alternative anastomosis between the gallbladder and intestine in cases where there is obstruction, growth or stricture of the common duct.

Dr. Tosati presented a series of some 700 cases in which he had evaluated the transverse incision versus the vertical incision. He quotes extensively the work of Hamilton Bailey of London and of Max Thorek of Chicago.

Dr. Paolucci presented a series of 25 cases of mediastinal tumors treated by surgery, all of which recovered except one who succumbed on the tenth day to a heart complication. It was interesting to observe Dr. Paolucci using only local and regional anesthesia and employing the anteroposterior or lateral way of transpleural approach. This procedure is most illuminating.

Thus came to a close one of the most successful Assemblies of the International College of Surgeons as yet held outside of the United States.

At his home in Rome the American Ambassador to Italy, Mr. Dunn, gave a lovely reception for the local and visiting surgeons on Sunday following the close of the Assembly. It was indeed a colorful occasion and gave us an opportunity to meet and discuss Italo-American relations with members of the diplomatic staff. During the previous week the Hungarian and Peruvian Embassies had

entertained visiting members of the College.

The members of the International College of Surgeons were cordially invited to attend the Medical Congress to be held in Torino, May 27 to 30, 1948. The International Surgical Days were held by the International Blood Transfusion Congress, the National Congress of the Italian Hematological Society and the Piedmont-Liguria-Lombardy Radiological group who were holding joint sessions. It was fitting that this great and representative assembly should commemorate the life and surgical contributions of three of Italy's distinguished surgeons: Antonio Carle, Mario Donati and Ottorino Uffreduzzi.

Professor Mario Dogliotti, President of the Italian Section of the International College of Surgeons and Director of the Surgical Clinic of the University of Torino, was General Chairman of the Congress, and he was ably assisted in the conduct of this meeting by many of the prominent surgeons of Turin, all of whom were most generous with their time and lavish with their entertainment for the visiting guests. We were honored and delighted to be received into the homes of Professor Mario Dogliotti, Professor A. Bertocchi, President of the Piemontese Surgical Society, Professor U. Camera, famous orthopedic surgeon of Turin, and finally enjoyed a most colorful luncheon given by the Torino Medical Society.

I was very much interested and impressed by the work of Antonio Bobbio, Secretary of the Congress, of the Department of Surgery at the University of Torino. Interesting work and results in partial gastrectomy in the treatment of perforated gastric and duodenal ulcers was shown. He summarized the literature and concurred in the conclusion that subtotal gastrectomy should be done for (1) every resectable carcinoma of the stomach, (2) gross hemorrhage, (3) pyloric obstruction, (4) two or more perforations, (5) repeated hemorrhages from peptic ulcer, either duodenal or gastric.

In discussing the type of procedure ememployed Dr. Bobbio stated that the surgical group of Turin and vicinity largely followed the teachings of the late Doctors Donati and Uffreduzzi. Since 1937 practically all Italian surgeons have adopted the method of gastric resection for uncomplicated peptic ulcer cases, and the operation is now done in from 70 to 90 per cent of patients who undergo surgery for gastric lesions. The mortality range is from 2 to 5 per cent.

Professor Mario Dogliotti succeeded Professor Uffreduzzi in the Surgical Department of the University of Torino. He concurs in and practices the teaching of subtotal gastrectomy for the peptic ulcer syndrome.

I made a most interesting visit to the Ospedale Maggiore di San Giovanni in Turin. This is the city hospital, is quite modern, rather well departmentalized into surgery, medicine and the various specialties. It is staffed, however, by members of the University of Turin. I believe I am correct in saying that it is the combined thought and practice of Professors Dogliotti, Bertocchi and Bobbio that subtotal gastric resection be done as a procedure of choice in the peptic ulcer syndrome for the following reasons:

1. It completely removes the ulcer.
2. It offers the greatest economic safeguard for the safety of the patient.
3. It offers the greatest number of permanent cures.
4. It obviates the possibility of carcinoma.

It is interesting to note that Professor Dogliotti has recently published an excellent work on surgery, my only difficulty being that I am not too adept at the Italian translation. It is profusely illustrated, however, and his cuts are almost self-explanatory.

It was my privilege and pleasure to attend a meeting of the Societa Piemontese di Chirurgia at which time I was again fortunate in receiving the Socio Honorario. Again, as at the meeting of the Surgical Society in Rome, I was deeply impressed with the dignity and professional conduct of their meetings. The surgical clinics were put on early in the morning as in the meeting at Rome and were done in a most scientific way. Technic is good, operating room equipment is adequate.

Entertainment for the members of the meeting was most lavish and generous. Scientific papers were excellent and the attendance was large. The meeting closed with one of

the most colorful banquets I have yet attended at which the surgeons of Turin were most ably assisted by their charming and attractive wives.

ENGLAND

This most successful and delightful meeting in Turin having come to a close, my next opportunity for scientific investigation and observation was in England. Although I had visited many of the hospitals in London at previous visits, I was impressed with the age of these old institutions and how for many years they had been serving the public of the world's greatest metropolis. To that end I made some investigation and was somewhat surprised at the facts obtained which are as follows:

Westminster Hospital was founded in 1719, Guy's Hospital in 1725, St. George's Hospital in 1734, Winchester and Bristol Hospital 1736, London Hospital 1740, Middlesex Hospital 1745 and the University College Hospital in 1828.

In delving into the history of these grand old hospitals, it was only natural that the names of the great surgeons who worked in them previously should come to the forefront. I recall the name of Joseph Lister who opened the way to aseptic surgery for generations to come. Born in 1827, he had studied medicine in the University of London and later went to Edinburgh for postgraduate work where he became a pupil of James Syme, and incidentally married Syme's daughter. Later he became Professor at Edinburgh.

His old home city of London, however, beckoned for Lister's return, and he became Professor of Surgery at Kings College in London where he remained until his retirement. Needless to say he was one of the greatest and most revered surgeons, not only of England, but of the world. His contribution to surgery is monumental.

It was fascinating to stroll reminiscently around the streets of London and realize that one was walking in the footsteps of such men as Sir James Padgett, Sir Jonathan Hutchinson, Sir Victor Horsley, Sir William F. Teevan, Sir William Arbuthnot Lane, Sir Arthur William Mayo Robeson, Sir Rickman John Godlee. Outside of London proper was the matchless Lord Berkeley Moynihan and Sir Robert Jones, Sir Harold Stiles, Sir David Wilke—all of them mile posts of modern progressive advancement in surgical science throughout the rich history of England's political and surgical development.

St. Thomas' Hospital occupies a large and splendid range of buildings on the Thames embankment opposite the House of Parliament, Guy's Hospital is located in Southwark, and St. Bartholomew's in West Smithfield. These are the three endowed hospitals. In addition, there are Charing Cross Hospital, St. Mary's Hospital, Royal Free Hospital, all having medical schools attached, as does St. George's Hospital, London Hospital and Middlesex Hospital.

Among hospitals with no medical schools attached may be mentioned the Royal Northern Hospital, West London Hospital and the Metropolitan Hospital, Hampstead and Northwest London Hospital. There is also the British Postgraduate Hospital which is situated in Hammersmith, Duncan Road, W 12, London, whose chief surgeon at the present time is Professor Ian Aird. It was my privilege to visit his clinic and see the excellent work being performed by him and his staff, and the special follow-up system which they are using in this hospital as well as the splendid facilities for teaching.

At Professor Aird's invitation I had lunch with and met the staff. Professor Aird presented a number of interesting cases himself and other members of the staff were operating in adjoining rooms. The technic is excellent, the familiarity with anatomy is splendid and the discourse throughout the operation is indeed most helpful to the students and visitors who happen to be standing by.

Professor Aird was recently accorded the position of Professor of the Postgraduate, having come there from the Royal Infirmary and Medical School in Edinburgh.

It was my privilege to visit the Royal Northern Hospital where Mr. Hamilton Bailey is Surgeon and surgeon in charge of the Genito-Urinary Department. He does an enormous volume of work and does it also with the greatest ease and facility. He is very opinionated and precise in his methods, and his various assistants and nursing staff

seem to know exactly what he wants. I was impressed with the ease in manner with which he conducts his morning schedule. Mr. Bailey is a prodigious worker, writer, and one of the widest known medical authors in all Europe.

It was my privilege and pleasure to visit with him and his charming wife in their palatial home some twenty miles from the center of London. It was a beautiful drive through the country and I was amazed when I came upon this genuine old castle with some eight acres of beautiful, well-kept grounds including statuary, pools and evergreens. It was most interesting to be escorted through the twenty-two rooms in the house and be given by Mrs. Bailey a detailed history of each of them.

One of the nice things is the interest which Mrs. Bailey takes in the work of her husband, both in his writings and in his surgical schedules. They are indeed two charming and sincere people, and his worth to the people of London and England will pay dividends in appreciation long after he is gone.

The hospitals are in rather poor repair in England. This seems to be due rather to the lack of material available than to lack of funds. It is an interesting observation that work is somewhat segregated in the hospitals in London, for instance, urology at St. Peter's Hospital, colon surgery at St. Mark's Hospital, and so on. I was interested in the splendid cancer program at Middlesex Hospital.

I made a visit to Westminster Hospital to see the improved technic for repair of inguinal hernia devised by Dr. Tanner. This is a procedure in which the fascial sheath of the rectus muscle is divided and literally slipped over to repair the defect in the inguinal region. It has been followed for some three to five years and the results have been brilliant. A great many of the surgeons in England are now using the Tanner procedure for herniorrhaphy.

In order to become more conversant with the English plan of socialized medicine I went to the Home of the British Medical Association whose Secretary is Mr. Charles Hill. Much constructive work is done by this organization. They are now submitting a brochure to the government authorities which literally revises the methods of teaching, requirements for medical schools and so on. They were kind enough to present me with a copy, and the plan would seem to be both logical and workable, if accepted.

Briefly, this is my understanding of how the medical insurance system works after conversation with numerous physicians and surgeons in Great Britain: An employed man will have almost a dollar a week taken out of his pay for this insurance fund. His employer will add about 83 cents, and to that the Government will contribute about half a dollar. When the contributor has made the required number of weekly payments, which vary with different benefits, he and his family will be eligible for sickness, unemployment, maternity and other benefits. He keeps on paying as long as he works whether he draws from the net or not.

If the man is taken sick, he will receive about $5.20 a week plus $3.20 for his wife and $1.50 for the oldest child. The rest of the children are covered by family allowance payments under another social service program.

Just about everyone will be covered by the new insurance scheme although payments will vary, and while many middle class professional people will want to continue paying their own family doctors, they will probably sign up for free care if they need treatment by a specialist. The upper bracket income people can be expected to continue paying their own doctors. The Minister of Health, however, expects 95 per cent of the population to register as nonpaying patients, and if that should prove to be the case, Government statisticians figure a doctor could make up to $13,000 a year in Government payments.

Doctors are to be paid a "capitation grant" from the Government for each insured person they treat under the new scheme. They can limit their practice entirely to these "panel" patients or treat them part-time.

Health Minister Bevan proposed to supplement the capitation grants by a basic salary of $1,200 a year, but the doctors protested loudly, fearing that he meant to set up a full-time salaries service. In February the British Medical Association took a vote, and only 4,084 of the 29,000 doctors voted for

Mr. Bevan's plan. Eventually, however, a compromise was reached. The minister gave his assurance that no full-time state medical service would be set up without a new Act of Parliament, and some 8,639 general practitioners voted for the new plan on the second plebiscite.

FRANCE

After completing a very pleasant week in England, I returned to France where many historical shrines in medicine and surgery exist. I was particularly interested in the Hôtel Dieu because it is one of the oldest in Europe and said to have been established in

Fig. 1. Autopsy performed by Professor Jules Emile Péan and staff at the Hotel Dieu, Paris. From an original painting by Henri Gervex.

Practitioners who choose to join the service have the choice of being paid entirely by capitation fees or receiving a basic salary plus smaller capitation fees. Young doctors setting up in practice after July 5, 1948, receive the basic salary and fees for three years and then may choose the arrangement they prefer. How much a doctor will earn under the scheme will depend upon whether he is an old hand or just starting out, whether he takes all "free" patients or some paying, how many he has in a year, and whether he is a general practitioner or a specialist.

the year 1660 A.D. It was destroyed, however, in 1772, but promptly rebuilt. It is located on the north side of the island opposite the Cathedral of Notre Dame. While the exterior shows its age, the interior is immaculate and very well kept. One of the points of interest is the impressive mural depicting Professor Péan and his teaching staff.

While strolling through the old art galleries of France, I found an original painting of Professor Péan and two of his assistants conducting an autopsy. This painting was done by Henri Gervex and depicts the peculiar

lighting arrangement in the Hôtel Dieu in which the recessed windows in the roof will permit the greatest influx of natural light for the benefit of the operating rooms, etcetera.

After this very interesting visit to the Hôtel Dieu, I visited the Morgue. It is stated that this morgue dates from the fifth century and is the spot where bodies of unknown persons who have perished by accident, murder or suicide are exhibited so they may be identified by friends or relatives. If these bodies are not claimed within a certain period of time, they are either buried or given over to the medical institutions for scientific purposes.

Upon the occasion of this particular visit, there were some forty or fifty bodies awaiting identification. I was impressed with the many means of identification which were employed by the officers in charge of this morgue. Not only finger prints but the length of arms, bones in the arm, legs, moles on the face, scars, hair, teeth, and every available means to identify the body were used. It is really a pathetic sight to stroll through this morgue and see the fine young people, especially young girls, expectant mothers, who have voluntarily paid the supreme sacrifice.

My next visit was to the Hôtel des Invalides. The buildings, which stand some 600 feet back from the River Seine, were begun in 1671 and comprise some 30 acres. It was built by Louis XIV to care for the aged servants of the Court, but later it was also used for invalid soldiers. At the present time some 5,000 to 6,000 disabled veterans of French wars are living there and receiving nursing and medical care at government expense.

It is the general impression of the tourist that the Hôtel des Invalides, with its gilded dome surrounded by a tall wrought iron fence, is only the tomb of Napoleon. The hospital buildings are situated to the right and back of the tomb. The general plan of caring for the veterans is much on the order of the American Veterans facility.

In 1937 I had visited the house in Warsaw, Poland, where Marie Sklodowska was born on November 7, 1867. I was then told that she was the youngest of five children and that as an orphan at the age of seventeen she became a governess to the children of a rich gentleman, saved her money and came to the University of Paris at the age of twenty-two and enrolled as a student in physics.

During the same year, 1937, I came to the Sorbonne University of Paris to study cancer and here found the true story of events as they happened to Marie Sklodowska. She must have been attractive as well as brilliant, because in July, 1895, she married her teacher in physics, Professor Pierre Curie, moved into his laboratory, and the two continued their studies until they announced to the world the discovery of radium and polonium from mineral pitchblends. In 1903 the Curies were jointly awarded the Nobel Prize. When Professor Curie was run over and killed by a vehicle in Paris, Marie Curie succeeded him as Professor of Physics.

The next major event was the creation of a Radium Institute by the University of Paris in which Madame Curie was made head of the research department. In 1921 she was invited to the United States where she received from the hand of the President the gift of a gram of radium from the American people. She returned again in 1929 and was given a check for $50,000 with which to pursue her studies in research.

Madame Curie died July 4, 1934, at the age of sixty-six. Her close contact with radioactive substances no doubt hastened her death which resulted from pernicious anemia.

On my return visit this year I saw the great work in cancer therapy being continued after the method of fractional x-ray therapy by Coutard and radium therapy after the method of Regaud. The clinics are crowded every day with people from all over the world who come feeling that the commonly known Curie Institute is the oldest and should be the best. I have never seen as many cancer patients anywhere else.

I was grateful for another visit to the shrine of endeavor of this great scientist, Marie Curie. The staff is eager for every new discovery that may come from the Atomic Energy Commission, especially cobalt because of its implied equal efficiency and marked reduction in cost.

It was a source of regret that I did not

have an opportunity to see more of the work of the surgeons of Paris since many of them were away for summer vacation. I hope to return there next year for a visit with them.

My return home was on the Queen Elizabeth. Here I had the opportunity of meeting Professor Robert McWhirter of The Royal Infirmary and Medical College in Edinburgh. There were some thirty surgeons aboard and we had the privilege of hearing Dr. McWhirter explain his more or less revolutionary management of carcinoma of the breast. The Edinburgh school has embarked on a second five-year plan of procedure in breast management which is roughly as follows:

In those breasts which present lesions with or without apparent metastases, only simple mastectomy is performed without invading either the supraclavicular or axillary areas. After this operative procedure, x-ray therapy is employed, using a special technic with emphasis upon filtration as designed by the Edinburgh group, and these treatments are carried out rather methodically and after a definite order of procedure. Working with the Minister of Health, they are able to follow more closely the results of their treatment, and the cases are grouped without respect to age, stage of disease or extent of spread. Professor McWhirter emphasized a study of a cross section of people suffering with the disease rather than taking any single group from which statistics might be obtained.

The surgeons aboard the Queen Elizabeth were much impressed with his discussion of the subject and his results obtained as was evident from the low mortality statistics which they have been able to obtain over the first five-year period. Since it is a rule of the Minister of Health that statistics on cancer are not to be given out under a five-year period, it will be some three years before the second study can be evaluated. In the meantime, however, the first five-year study will be available and the profession will be able to place a proper evaluation on this type of treatment over a ten-year period of time. The surgical profession of the world looks with eager eyes to the work of Professor McWhirter and the Edinburgh school.

Thus ended the most enjoyable two months in the various cities and countries of Europe and a most pleasant association with many surgeons of these countries.

Our Present Knowledge of Gastric Cancer*†

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OUR present knowledge of gastric cancer has evolved through several phases, each one contributing a new opportunity for observation, study and generalization. The first began with the opportunity to see disease in its last and fatal stage at autopsy. Early gastric cancers usually do not kill their hosts; therefore, autopsy pathologists rarely, if ever, see early cancer. Moreover, autopsies are accompanied by premortem and postmortem changes which prevent us from seeing the true cytologic facts which are necessary in the study of cytogenic and histogenic evolution of cancer. The autopsy picture today is very little better than it was when reported by Morgagni (1769), Baillie (1793), Abercrombie (1824), Cruveilhier (1835–1842), Müller (1860), Hauser (1883) and Welch (1885).

The second phase may be called the clinical diagnostic phase before gastric roentgenography and roentgenoscopy. Clinicians of the last century also never recognized gastric cancer in its early stages. Bright in 1860 reported 116 abdominal tumors and did not mention gastric cancer; Osler and McCrae (1900) reported 150 gastric cancers which they saw clinically and all were in the hopeless stage; 9 were operated on and the medical and surgical mortality rate was 100 per cent.

The third phase was surgical; it grew gradually only with the slow advance of our knowledge of gastric anatomy, asepsis, anesthesia and surgical technic, all of which were very crude up to and including the first two decades of the twentieth century. It took many years of experimentation on dogs by such daring surgeons as Merrem (1810), Gussenbauer and Winiwarter (1876) and Kaiser (1876–1877), Torelli (1865), Péan (1879), Billroth (1881), Wölfler (1880), Doyen (1892), von Hacker (1894), Murphy, W. J. Mayo [19-23] (1894) and many operations on human beings even to begin a reasonable and relatively safe surgical approach to the disease. It has taken much longer to educate general practitioners to the clinical recognition of the possibility of gastric cancer being present without classical textbook signs and symptoms, and to teach them that early cancers can be removed surgically with low mortality, increased comfort and prolonged life for the patient.

The fourth phase has been one of the greatest factors in the early recognition of the disease and its early treatment. This did not begin until the second decade of the twentieth century and was not well developed before the end of the second decade and beginning of the third decade. Despite the fact that Roentgen discovered x-rays in 1895, it was not until 1911, 1912 and 1913 that Holzknecht (1911), Groedel (1912), Haudek (1912), Forssell (1913), Carman (1913) and other roentgenologists of that period perfected a technic for x-ray examination of the stomach and had time to compare their observations with those made at operation and in the surgical laboratory. It was then that physicians began to see early gastric cancers under the most favorable conditions for study. Some years before the use of x-rays for the study of the stomach I reported [16] (1910) a study of 216 resected gastric cancers which was the first relatively large series that had been seen. In that report I stated: "The question—do ulcers become malignant as one of their sequelae? seems from my material at least to be answered in the affirmative. What percentage heal, perforate or become malignant is impossible to determine." This is just as true today, after the observation and study of 4,016 gastric cancers and 2,912 gastric ulcers, from 1907 to 1947 inclusive, as it was in 1910.

The fifth phase began about 1912 when I started my studies of living cells without fixation, without embedding and without the use of stringent stains, in other words, without

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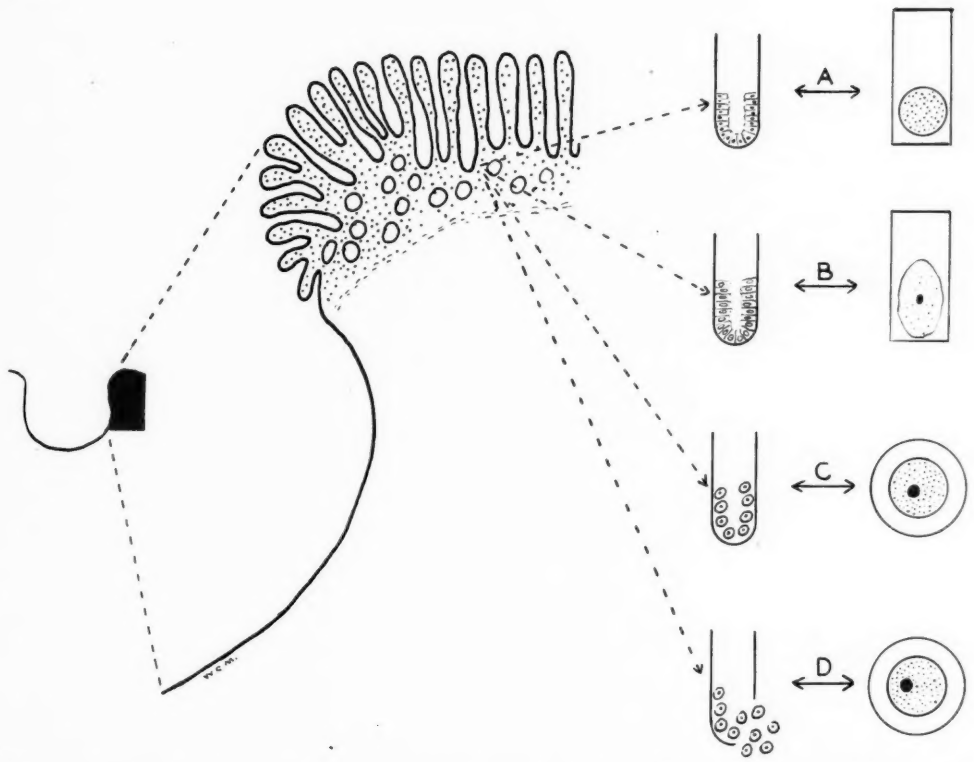

Fig. 1. Diagram of a section through the border of a gastric ulcer. Some tubules show adult types of cells (A); some show a regenerative reparative type of cell (B); some (C) show cancerlike cells (secondary cytoplasia); and some show the cancerlike cells in the stroma (D). The average diameter of lesions A and B is 1.58 cm., of C, 1.49, and D, 2.17 cm.

the many artifacts which have characterized most, if not all, of our histologic methods. It was in this phase that roentgenologists began to see small lesions but were not certain whether or not they were cancers. The surgeon, however, was willing to explore and resect. That material furnished the opportunity which evolved some definite cytologic and histologic facts.[17, 18] It was stated that the majority of chronic ulcers showed adult type cells in their tubules; some showed a regenerative type of cell; a small series (10 to 14 per cent) showed intratubular cells morphologically identical with definite cancer cells, and others showed the line of demarcation between the tubules and the surrounding stroma partially obliterated with some of the cancerlike cells in the stroma (Fig. 1). While these observations were very suggestive, at no time did I ever call the ulcers with cancerlike cells within the tubules "cancer." I called that condition "secondary cytoplasia" for identification and study and found it in from 10 to 14 per cent of resected chronic gastric ulcers.

The average diameter of all resected benign gastric ulcers was 1.58 cm. (Table 1), the average diameter of those with secondary cytoplasia was 1.49 cm., and the average diameter of those with some of the cancerlike cells in the stroma was 2.17 cm. This last figure was very suggestive because I had long since learned empirically that the great majority of chronic gastric ulcers larger than 2.5 cm. in diameter were definitely cancerous. It is also interesting and important to note

TABLE 1. DATA ON GASTRIC ULCERS RESECTED IN SEVEN YEARS.

Year	1941	1942	1943	1944	1945	1946	1947	Totals
Number excised	72	86	132	94	119	112	120	735
Average size in cm.	1.4	1.3	1.7	1.7	1.8	1.3	1.87	1.58
Percentage under 2.5 cm. in diameter	87.5	90	74	75	72	75	75.8	78.5
Number of resected gastric cancers in same years	59	110	119	109	138	111	103	749

TABLE 2. DATA ON GASTRIC CANCERS REMOVED IN 30 YEARS.

Year	No.	Nodal Involvem. %	Size in Cm.		All Cancers		
			With Nodal Involvem.	Without Nodal Involvem.	Average Size	Under 2.5 Cm. Diam., %	2.5 Cm. Diam. or Larger, %
1918	72	63	6.7	4.7	5.7	6.1	93.9
1919	109	65	7.6	7.1	7.3	4.7	95.3
1920	122	61	6.7	6.9	6.8	5.5	94.5
1921	78	51	6.7	5.7	6.2	5.3	94.7
1922	128	59	6.9	5.5	6.2	1.3	98.7
1923	117	51	6.6	5.0	5.8	11.0	89.0
1924	98	56	7.0	5.3	6.0	5.8	94.2
1925	102	59	6.7	4.9	5.8	4.2	95.8
1926	121	47	6.7	5.2	5.9	9.8	90.2
1927	135	45	6.2	5.7	5.9	5.8	94.2
1928	132	53	6.7	5.4	6.0	8.9	91.1
1929	136	41	7.1	4.9	6.0	5.5	94.5
1930	110	43	7.4	4.3	5.8	7.8	92.2
1931	108	56	7.5	6.1	6.8	4.8	95.2
1932	64	57	6.5	4.8	5.6	10.0	90.0
1933	61	45	6.9	5.3	6.1	6.6	93.4
1934	99	54	7.5	6.4	6.9	6.0	94.0
1935	83	46	7.4	6.2	6.8	7.0	93.0
1936	98	51	6.7	4.8	5.8	21.0	79.0
1937	101	58	6.8	6.1	6.4	10.0	90.0
1938	111	58	7.3	5.7	6.5	9.0	91.0
1939	114	50	6.1	4.9	5.5	14.0	86.0
1940	109	71	6.9	4.4	6.0	17.0	82.0
1941	59	66.1	7.2	4.55	5.8	13.7	86.3
1942	110	61	6.9	5.2	6.0	10.0	90.0
1943	119	70	6.8	5.4	6.1	9.8	90.2
1944	109	66	7.2	5.1	6.1	9.0	91.0
1945	138	72	7.1	4.8	5.9	7.0	93.0
1946	111	65	6.3	5.0	5.6	5.6	94.4
1947	103	67	7.2	6.2	6.7	9.1	90.0
Total	3,157	56%	6.88 cm.	5.36 cm.	6.06 cm.	8.36%	91.6%

that 8.36 per cent of our resected gastric cancers were under 2.5 cm. in diameter and that some of them were associated with involvement of the lymph nodes (Table 2). In

other words, there are such things as small cancers despite the fact that the average diameter of all of our cancers was over 6 cm. The great probability is that all gastric cancers were once small. We are beginning to see some of these small cancers as a result of clinical suspicion, roentgenoscopy, surgical diagnostic exploration, resection and better methods of studying surgically removed specimens immediately after their removal.

CONCLUSIONS

1. Only 25 per cent of all gastric cancers seen clinically are resectable.

2. In the last 30 years, only 8.36 per cent of all resected gastric cancers have been smaller than a quarter (2.5 cm.).

3. At least 3.4 per cent of all resected gastric cancers smaller than a quarter already are associated with involvement of the lymph nodes.

4. If the roentgenologist, endoscopist, surgeon or gross pathologist says a gastric ulcer is smaller than a quarter, approximately 1 of every 10 of these ulcers will be cancerous.

In order to discover early gastric cancers it has been necessary to remove approximately one benign ulcer for every cancerous lesion; if this had not been done, 8.36 per cent of the gastric cancers would not have been discovered as relatively small cancers.

SOMMAIRE

Seulement 25% de tous les cancers gastriques reconnus cliniquement sont résectables. Dans les 30 dernières années, seulement 8.36% de tous les cancers chroniques résectés avaient un volume moindre de 2.5 cm. Au moins 3.4% de tous les cancers gastriques résectés étaient plus petits que 2.5 cm. et étaient associés avec métastases dans les nodes lymphatiques. Si le roentgénologiste, l'endoscopiste, le chirurgien et le pathologiste disent qu'un ulcère gastrique est plus petit que 2.5 cm., á peu prés un de 10 ces ulcères est cancereux.

Afin de reconnaitre les cancers gastriques á temps, il est nécessaire d'enlever tout ulcère bénin. Si cela n'avait pas été fait, 8.36% des cancers gastriques n'auraient pas été reconnus comme petits cancers.

SUMARIO

Solo un 25 % de las canceres del estomago que son reconocidos clinicamente son resectables. En 30 años de experiencia, solo 8.36% de los canceres gastricos que fueron resectados, el tamano del tumor fue de menos de 2.5 cm. de diametro y de estos casos por lo menos un 3.4% presentaron metastases en los ganglios linfaticos. Aproximadamente cuando se diagnostica la ulcera gastrica de tamano menor de una pulgada de diametro uno de cada dies casos son o se hara cancerosos. Por lo tanto es menester el resectar aproximadamente una ulcera benigna por cada lesion cancerosa si se va a descubrir tempranamente el cancer gastrico. Solo asi es como se ha podido descubrir un 8.36% de casos de canceres gastricos de muy pequeno tamano.

RIASSUNTO

Una resezione e' possibile solamente nel 25% dei carcinomi che occorrono all'esame clinico. Negli ultimi 30 anni solamente 1'8,30% di tutti i carcinomi sottoposti ad una resezione raggiungeva un diametro inferiore a cm. 2,5. Anche in questo piccolo gruppo di casi, il 3,4% rivelava gia' un'infiltrazione neoplastica delle linfoghiandole.

L'A. giunge alla conclusione, estremamente pessimistica, che sopra 10 ulceri dello stomaco aventi un diametro inferiore a cm. 2,5 (stabilito in base ad un esame comprensivo radiologico, endoscopico, chirurgico e patologico), una di queste ulceri e' carcinomatosa. Per giungere ad una diagnosi precose del cancro dello stomaco e' stata necessaria asportare un'ulcera benigna per ogni lesione carcinomatosa. Se questa proporzione non fosse stata seguita come una regola, 1'8,36% dei caneri dello stomaco sarebbero sfuggiti perche' in una fase ancora relativamente precoce di sviluppo.

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Selection of Operation to Be Used for Carcinoma in the Several Portions of the Large Bowel*

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WHILE complete unanimity has not been reached as to the best types of operation for carcinoma developing in the various portions of the large bowel, present tendencies point to crystallization of opinion as to the preferred operation for uncomplicated carcinoma of the abdominal colon. Indeed, for uncomplicated carcinoma of any part of the colon there has been a strong swing toward a one-stage wide resection with end-to-end anastomosis. With thorough preoperative emptying of the intestinal tract and its relative sterilization by antibiotics, these operations are being performed in large numbers with an unprecedented low mortality and freedom from wound infection. A lingering fear of infection in the abdominal wall has led a few operators to practice a delayed closure of the outer layers of the wound. On the other hand, others who have protected the wound edges during the bowel resection and who have avoided leaving materials in the abdominal wall which devitalize tissue or which hold and fix infection, such as catgut, cotton or silk, and have substituted nonirritating metallic sutures and ligatures of small bulk, have had better results and fewer wound complications from a primary closure. There remain some differences of opinion as to use of a side-to-side or end-to-end closure when the ileum is to be united to the colon, as with resection of the right half of the colon. The end-to-end anastomosis with oblique division of the ileum is simpler, and while the lumen of the anastomosis cannot be made as large as with a side-to-side anastomosis, it will, if properly formed, be larger than the ileocecal valve, and quite adequate. The two blind ends formed in the side-to-side anastomosis, especially if made rather long, are subject to distention, and in a number of instances have been responsible for a "blowout," and fatal peritonitis.

A side-to-side anastomosis between the ileum and transverse colon, however, may be considered as the first stage of a two-stage operation for carcinoma of the cecum or ascending colon that is obstructed or that has a walled-off perforation or local abscess, particularly as it is a relatively simple procedure and eliminates the need of a colostomy, but it has the disadvantage of retention of a cancerous loop, subject to distention by the reversed fecal currents of Bond, as well as by the normal peristaltic currents of the intestine. Preferable in many cases is a temporary proximal colostomy or complete division of both colon and ileum, with anastomosis of the proximal end of the ileum to the distal end of the colon. The proximal end of the colon with the distal end of the ileum are then brought out of an abdominal wound to form a double-barreled enterostomy, which can be irrigated and cleansed, alternately using the colonic and then the ileac opening. By keeping this malignant loop empty and free from intestinal contents a rapid subsidence of any inflammatory reaction about the tumor may be achieved and the most favorable condition, under the circumstances, produced for the later en bloc removal of the defunctionalized loop with the adjacent invaded tissue, and for a satisfactory abdominal closure.

The Mikulicz-Paul operation has been largely discarded as a routine procedure for the removal of colonic cancer. Only one large clinic, to my knowledge, has continued to advocate its use. Nevertheless, on the rather rare occasions when a serious complication is found or is developed during an attempted resection of the colon, the Mikulicz-Paul procedure may enable the operator to exteriorize the diseased loop of intestine and to terminate the operation quickly. Otherwise, a one-stage resection with anastomosis has a lower mortality and a much lower morbidity.

After a well performed primary anasto-

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mosis and end-to-end closure, about two-thirds of patients are in condition to leave their beds on or before the third postoperative day, and to be discharged from the hospital by the seventh postoperative day. Its most common important complication is ileus, which usually may be prevented or relieved by an aspirating intestinal tube or, for sigmoid resections, an indwelling small rectal tube or catheter lying just below or through the anastomosis. Early the tube is to be frequently cleared by small saline injections, and later, evacuation is produced by the instillation of 30 to 60 cc. of 50 per cent glycerin. An appendicostomy or small tube enterostomy may be required to prevent or relieve an ileus.

In contrast, a patient after the Mikulicz-Paul operation may have learned how to care for his colostomy and be able to leave the hospital at the end of two or three weeks. Should he remain in the hospital, an attempt may be made to close the double colostomy about this time, but some surgeons with large experience have had so many failures that they prefer to send the patient home with his open colostomy for two or three months, after which he returns to the hospital for the closure. If this is successful and he escapes any persistent postoperative wound infection, he may be able to leave the hospital, wearing a supporting belt, after an additional two weeks. But as there is danger in securely closing the wound without drainage at the time the colostomy is closed, the incidence of postoperative incisural hernia is relatively high. When the Mikulicz-Paul operation is used for carcinomas of the cecum or ascending colon, with an associated ileostomy and colostomy, there is an additional danger, for an ileostomy, possibly largely from the heavy loss of fluid and nutritive material, has given a rather high mortality in expert hands. The mortality reported in 1946 from the Lahey Clinic was approximately 11 per cent in over 450 cases.[1] The ileal contents leaking upon the skin often produce a serious and distressing erosion. However, if an intact ileal end projecting 5 to 8 cm. above the skin is formed, this may be covered by a nonconstricting thin elastic latex tube, which may be adjusted to convey the liquid small bowel contents into a collecting bag without spillage.

For carcinoma of the sigmoid, for which the Mikulicz-Paul operation was first introduced, the operation is notorious for the high incidence of recurrence of the carcinoma in the abdominal scar, the bowel contiguous to the anastomosis and the associated mesentery. This is due to the fact that so much viable bowel and mesentery is required to form the apposed arms of the loop, to reach through the abdominal wall and to project as two free ends for 5 cm. or more above the skin, that the operator is frequently unable to remove sufficient of the involved bowel and mesentery. Thus if 6 cm. of bowel and mesentery on each side are required to form the apposed intraäbdominal arms of the loop, 4 cm. to pass through the abdominal wall and 5 cm. to project above the skin, 30 cm. more bowel and mesentery would be retained than if the more radical single stage, end-to-end anastomosis were used. Many patients have died because a more radical type of operation than the Mikulicz was not used.

In the one-stage end-to-end anastomosis, Raymond W. McNealy has particularly emphasized important technical details. By many experiments on lower animals he has demonstrated the advantage of a single row of well placed fine silk sutures. In the dog, these sutures are practically all eventually discharged with the feces. He has emphasized the importance of having vital bowel edges, and of not devitalizing these edges by broad or even narrow clamps, or by closely placed or continuous sutures. Also that a single row of sutures is adequate for the posterior row, but that a second row may be needed to reinforce the lateral edges and the anterior margins in the anastomosis. For the outer sutures I prefer interrupted 35 or 38 gauge stainless steel wire. Partial or even complete obstruction has repeatedly followed the use of multiple rows of sutures in an intestinal anastomosis. In a patient who probably had four rows of sutures in a resection and anastomosis of the sigmoid, an emergency proximal colostomy had been required for postoperative obstruction. Later I found the bowel completely obstructed at

[1] Cattell, R. B., and B. P. Colcock: Primary Resection of the Right Colon, Surg. Clin. North America 26:606 June 1946.

the zone of anastomosis. In an anastomosis over clamps there is not only the danger of excessive inversion of the bowel edges but often it is difficult to align the bowel edges accurately, particularly at the lateral margins. If, inadvertently, a lateral margin in one clamp is displaced to the right, and the opposite lateral margin in the opposing clamp displaced to the left, a stricture and partial obstruction at the anastomosis may be formed. In several such cases we have used a colostomy or appendicostomy proximal to the stricture to dilate it. By introducing a catheter, with a funnel at the outer end, into the colostomy, a length of fine silk thread may be washed through the colon and stricture, and out through the anus or a rectal tube. The end of the fine thread may be carried by the current of warm water even through a very small stricture. The thread is then withdrawn fastened to a well lubricated fishline, which in turn is threaded by a strong, pointed needle through the conical tips of rubber catheters or rectal tubes of increasing size, which in succession are carefully pulled through the stricture. If the fishline be left in place for several days it alone will tend to enlarge the stricture or overcome an obstructive angulation.

The advantage of the open end-to-end anastomosis is that it enables a large lumen to be accurately formed and largely eliminates the danger of a secondary stricture. It may be performed with satisfaction for carcinoma when the bowel has been thoroughly emptied of fecal matter and barium, and the patient adequately prepared with antibiotic measures that sterilize the upper and lower bowel contents. With a low obstructing carcinoma, it may be possible to introduce a rectal tube or catheter, guided by a proctoscope, to a point above the growth and by irrigation to empty and cleanse the proximal colon. But at operation the bowel above the growth will at times be found more or less filled with fecal material or barium. After liberating the segment of bowel and omentum to be removed, the operator may attempt to milk back the intestinal contents and quarantine the area by soft, rubber-shod intestinal clamps. The bowel ends when opened are carefully swabbed out and an anastomosis performed with more or less soiling. In such a case I much prefer a closed anastomosis, excising the segment of bowel by cautery between Furniss clamps, which leave the narrowest margins of devitalized bowel, shirred on small pins, a modification of Donati's clamp method of closing the duodenum. In using the Furniss clamp, or its modifications, care should be taken not to char the bowel edges too close to the pin, as the pin may then fall off or fail to prevent leakage. Also, high frequency currents should not be used to divide the bowel, as these currents may be disseminated by adjacent salt pads and do irreparable damage to distant structures. The pins in the bowel ends are aligned a short distance apart and the posterior row of interrupted 0 silk sutures inserted through the cleared serosa to the submucosa. If exposure of the posterior edges is difficult, this row of sutures need not be tied until the entire row is placed, when the sutures are tied and the ends cut close to the knots. The anterior row of interrupted sutures is then inserted, covering the two pins. The pins are withdrawn and the lateral and anterior margins reinforced by additional fine sutures. This type of anastomosis may be used for carcinomas of the large bowel situated anywhere from the cecum to the peritoneal reflexion on the rectum.

For malignant polyposis the entire colon and upper rectum may be removed, with anastomosis of the end of the ileum to the rectum. Such anastomoses between the ileum and lower rectum I have found satisfactory for ulcerative colitis as well as for diffuse polyposis, provided the sphincters anii are functional.

In 3 cases, after removal of the colon, rectum and sphincters, I pulled the end of the ileum through the perineum for a perineal ileostomy, but the ileal contents proved to be too irritating for the perineum, so that it was necessary to transplant the ileostomy to the abdominal wall in two of the patients.

It is feasible to resect the entire colon in one or two stages without temporary or permanent colostomy. In the two-stage colectomy I consider it of advantage to remove the right half of the colon at the first stage, with end-to-end anastomosis between the ileum and transverse colon. At the second stage, the

left colon is removed, the end of the ileum cut free and anastomosed to the rectum. Such anastomoses, with the Furniss clamp, are desirable when there is diffuse polyposis or ulcerative colitis. Thus the patient remains in much better condition between stages than if an abdominal ileostomy is formed at the first stage, with its contamination of the abdominal wall and debilitating loss of intestinal contents.

I have found it quite possible to make the end-to-end anastomosis below the pelvic peritoneal reflection, even to 4 or 5 cm. above the sphincters. These very low anastomoses, especially in obese patients, may be quite difficult, and they may be more subject to secondary leakage.

With resection of the rectum for carcinoma at least 4 cm. of normal-appearing bowel below the tumor should be removed with the specimen. Many thorough studies have shown that the downward lymphatic spread of carcinoma is infrequent beyond 2 cm. below the growth unless the superior lymphatics have become blocked, while evidence of caudal permeation of malignant cells beyond 4 cm. is very rare. Thus the opinion of Miles, which long guided the surgeon, that cancer of the rectum and sigmoid spreads downward as well as it spreads upward and laterally, has been disproved.

Lower Rectal Carcinoma. The area of rectum between 6 and 14 cm. above the perineum is a very common seat of carcinoma. In this segment anastomotic operations may be difficult or insufficiently radical. As the anus and sphincters are not involved by the disease, surgeons have devised a variety of operations with a normal perineal outlet. Many such operations with an approach from below through the perineum, dorsum, sacrum or vagina were introduced during the first quarter of this century. In that of Hochenegg, the sigmoid was telescoped through a section of the lower rectum, which had been denuded of its mucosa. In others an end-to-end union was formed, using Petz clips or other method to avoid soiling; or a pull-through operation after the plan of the Whitehead hemorrhoidectomy was used. These early resections from below, with sphincters preserved, proved to be very unsatisfactory. They were not sufficiently radical, secondary infection was common, and the lines of anastomosis tended to break down, with fecal extravasation, spreading pelvic infections and secondary sinuses and fistulas. Those who, like myself, practiced such operations in their earlier experience have unpleasant memories of undue morbidity and mortality from the rectal resections from below. A few years ago Wangensteen reported a small revival of operations of this type with the advantage of a more modern technic, but also with discouraging complications.

Experience has proved that the resections from below, except for anal cancer, are inadequate and dangerous. To be sufficiently radical, to have adequate information as to the patient's disease, to mobilize the viable bowel sufficiently and widely remove invaded tissue, an abdominal approach is necessary. Technically, the placing of sutures in the bowel leads to complications. The sigmoid and rectum continue to have longitudinal peristaltic contractions after the operation, so that the sutures tear out or cut through, with wound separation and sinus or fistula formation. Fecal discharges, a common source of infection, should not come in contact with the wound until union has occurred. Perineal drains or wound openings in an area where sterility cannot be well maintained should be eliminated. Telescopic operations, in which the upper segment of bowel is pulled through the undivided lower rectum and sphincters, are followed by strangulation, gangrene and ascending infection in the withdrawn bowel. If, however, the sphincters are denuded, as practiced by Harry E. Bacon, then the anal opening may be enlarged sufficiently so that the withdrawn bowel is not strangulated.

It is not surprising that the majority of surgeons turned to the Miles operation, first published in 1908, which was radical yet had a much lower mortality and fewer complications than those with a pelvic approach. Miles, believing in the downward diffusion of rectal cancer, therefore unnecessarily removed the lower rectum, anus and pelvic floor, leaving a large pelvic cavity to granulate slowly, delaying complete postoperative healing for several weeks or months.

He considered it necessary to line the pelvis with mobilized peritoneum and to form a pelvic diaphragm, usually with catgut sutures. But the catgut sutures on this peritoneal surface led to secondary adhesions; and an occasional patient developed obstruction from traction and angulation of the bowel, or from a loop of intestine slipping through an opening between sutures in the pelvic diaphragm. Contrary to general opinion, there is less trouble from pelvic adhesions when the pelvis is left denuded of peritoneum, as shown by the rarity of obstruction from pelvic adhesions in over 400 cases in which we made no attempt to cover the denuded areas with peritoneum.

The most objectionable feature of the Miles operation has been the abdominal colostomy. Some colostomies are quite amenable to regulation by irrigations and conventional care, and may be shown to an admiring audience. Others are capricious, have uncontrollable discharges at inopportune times; and sputter and spatter the patient from head to foot, as well as a wide area of the bathroom, during irrigation. Again there is the relatively dry but odorous type that inopportunely belches gas when the patient bends over or sits down, and renders it embarrassing to practice a profession or to retain a clerical position. I have moved a considerable number of such colostomies through the perineal scar. Irrigations then can be made with the patient sitting upon a toilet seat, without disrobing; discharges of gas have been much less noticeable, intestinal evacuations less frequent; and a number of the patients have developed a warning sensation of an approaching evacuation, enabling them to go without a protective pad.

For carcinoma of the sigmoid and upper rectum, wide resection and end-to-end anastomosis should have first consideration. When this is not feasible, and for cancers at least 4 cm. above the sphincters, a radical pull-through type of operation should be considered.

For cancer of the rectum within 4 cm. of the sphincters or 6 cm. of the perineal skin, a Miles type of operation may be elected. Personally, I prefer an abdominoperineal resection with a perineal colostomy because this has been preferred by the patients, and requires less care than an abdominal opening. As to this, patients who have the modern perineal colostomy or who have had an abdominal Miles colostomy transferred to the perineum will agree, although it may not yet have general surgical approval.

For epitheliomas limited strictly to the anus, a wide perineal resection with perineal colostomy may be adequate, as there seems little tendency for these growths to spread upward into the pelvis and abdomen. If a large perineal hernia or prolapse follows, as is not uncommon, the patient may prefer an abdominal colostomy, which also may develop a troublesome hernia and prolapse, but with more tissue for adequate repair. For a large perineal hernia I have implanted a support of stainless steel mesh having a central hole through which the bowel is passed to the skin.

The question as to the desirability of removing the lymphatics running from the anus, on the medial sides of the thighs, to the medial lymph nodes of the groin is to be considered with anal epitheliomas. Invasion of the lymphatics has, in my limited experience, indicated an advanced and ineradicable disease, but this additional procedure may be desirable in certain cases.

In the pull-through operation which I have practiced with minor variations since 1930, the abdomen is opened under spinal anesthesia, through a lateral incision along the outer border of the left rectus or, if there is a median scar, by excision of the scar. The preliminary intraäbdominal examination from diaphragm to pelvis indicates whether the operation will be radical or palliative. In the presence of ineradicable metastatic nodules in the liver or elsewhere, although the same operative technic is usually employed, the operation can be only palliative. In any case, every effort will be made to avoid a colostomy. The small intestines and omentum are walled off by moist saline gauze pads in the upper abdomen. The left lateral leaflet of the sigmoid is divided wide of the bowel. The left spermatic or ovarian veins and left ureter are freed and displaced to the left; the hand introduced under the sigmoid, and the sigmoid, sigmoid mesentery, rectum and

adjacent peritoneum elevated and separated from the underlying great vessels and sacrum to the coccyx below, the ureter on the right side, and the third, fourth and fifth lumbar vertebrae above. The mesentery of the sigmoid, especially about the inferior mesenteric vessels, is palpated for enlarged and indurated lymph nodes. An incision is made through the right peritoneal leaflet medial to the ureter, and is extended across the rectum through the vesical or uterine reflection to join the peritoneal incision on the left side. A finger introduced under the upper medial edge of the peritoneal incision on the right side hooks up the superior hemorrhoidal, inferior mesenteric and the first and often the second sigmoid vessels, which are clamped, divided, and doubly ligated with transfixion, using 0 chromic catgut, which is securely seated in the groove left as the curved hemostatic clamp is removed.

The rectum is separated anteriorly from the seminal vesicles and prostate, or the cervix and vagina, and the lateral rectal ligaments divided wide of the bowel, with the small middle hemorrhoidal arteries, which may not require ligation. Care should be taken to avoid the anterior sacral veins, which are difficult to ligate, as well as the obturator veins at the sides of the pelvis. The mesentery of the sigmoid is spread out and usually divided between the vascular arcades on a line to the midsigmoid. Bleeding vessels are tied with fine silk, and the lower edge of the upper segment of sigmoid tested for vascularity by incising small vessels on its wall; and also for sufficient length, usually about 12 cm., to reach from the promontory of the sacrum through the anus. If there is insufficient length, the lower part of the descending colon is liberated, with division of its lateral peritoneal leaflet. A tape of folded gauze 1 m. long is tied about the midsigmoid at its lower zone of vascularity, and the ends of the tape packed against the floor of the pelvis to reduce oozing and serve as a guide in the perineal part of the operation. Should there be a malignant polyposis involving also the descending colon, this portion of bowel, with the splenic flexure and terminal portion of the transverse colon may also be liberated with division of the inferior mesenteric vessels and sufficient of the gastrocolic omentum to permit the terminal portion of transverse colon to be brought through the anus.

The abdominal wall is closed with layer sutures of 35, 32 and 30 gauge stainless steel wire, with a sump drain running from the pelvic floor through or lateral to the abdominal incision.

The perineal phase is immediately started with the patient in the lithotomy position. The rectum is wiped out and carefully packed with gauze wet with 3.5 per cent tincture of iodine, and a midline incision made through the posterior border of the anus and sphincters to the base of the coccyx. With curved scissors the rectum is divided just above the sphincters and the upper margin grasped in hemostats for traction. The midline incision is deepened into the pelvic cavity along the right side of the coccyx, the finger introduced and the levatores anii on each side elevated from the rectum and divided wide of any infiltrated tissue, the fascial interval between the urethra, prostate and rectum is entered and the bowel withdrawn as any remaining attachments are divided. If infiltrated, the prostate, vagina, uterus, bladder or other pelvic organ is resected or liberated and withdrawn, attached to the bowel. The withdrawn bowel is wrapped in a towel and laid over the pubis, and the perineal wound and pelvis are inspected with the aid of a gynecologic trowel. Bleeding points are ligated and the pelvic floor and perineum closed in about four layers with interrupted sutures of 32 gauge alloy steel wire without drainage. The withdrawn sigmoid should lie loosely in the wound to allow for swelling and is not sutured to any adjacent structure. Dressings are applied and the sigmoid divided about 6 to 10 cm. from the skin. A week or ten days later, primary union having occurred, the protruding bowel is again amputated, this time about 2 cm. beyond the skin, with careful hemostasis. The bowel then spontaneously retracts within the anus and forms a union just above the sphincters. In the after-treatment, care should be taken to keep the opening of adequate size until any tendency to stricture formation has passed. For the first two months a quickly acting saline laxative is given to empty the intestinal tract every sec-

ond or third morning. Later, enemas may be used or the patient may establish a regular habit.

The sump drain gives the earliest sign of ileus, a sudden flow of clear serum being a signal for immediate gastrointestinal decompression. With an end-to-end resection, slight leakage from the anastomosis is early shown by odorous evacuation from the sump drain. If the leakage is slight and without definite abdominal and general symptoms, the sump drainage is continued for six or seven days for the establishment of a drainage tract, and is then withdrawn, with immediate reinsertion of a small perforated catheter which later is gradually withdrawn as the small fistula closes. If there is evidence of leakage into the general peritoneal cavity, the wound should be immediately opened, the anastomosis separated, the proximal end brought through the wound for a colostomy, the distal end exteriorized or isolated by a gauze drain, the distal end of which is passed through the anus while the proximal portion covers the contaminated pelvic floor. The abdominal wound is lightly closed with through-and-through 30 gauge wire sutures and the gauze drain removed through the anus five or more days later.

With a pull-through type of operation, if the bowel necroses or leaks back into the pelvis, with beginning perifonitis, the wound should be opened immediately and the terminal bowel pulled up into the wound for a colostomy, and a gauze drain placed and brought out through the perineum as just described. After several months it may be feasible again to establish an anastomosis or perineal outlet.

It would seem that for sigmoid and most rectal cancers we may now well discard the mutilative and unnecessary parts of the Miles operation, the colostomy, the ablation of the anus and pelvic floor, the pelvic diaphragm and yet retain or add to the really radical features of his operation. Especially desirable is a wide removal of pelvic peritoneum about the concer where we have found hidden recurrence after the Miles operation. For the less experienced operator dealing with growths above the pelvic floor, the lower rectum may be divided between clamps, the rectosigmoid with attached adjacent peritoneum, mesentery and lymphatics exteriorized, the pelvic floor covered by a folded strip of gauze, the end of which is pushed through the anus, and the abdomen closed without other drainage, following which the redundant colostomized bowel is resected. This relatively simple operation leaves a segment of rectum with the anus, enabling early dependent drainage, and later palpation of the pelvic floor for recurrence, and also the possibility of a later anastomosis of the colostomy to the terminal rectum.

SUMMARY

For carcinoma of the abdominal colon a single wide resection of bowel and adjacent mesentery, with end to end anastomosis, is popular. With the bowel empty and asepticized by antibiotics, an open type of operation with one or two rows of interrupted sutures has given good results. A few operators, fearing contamination of the abdominal incision, practice delayed closure of the abdominal wall. Even with ileocolic anastomoses, an end to end is supplanting the side to side anastomosis. With obstruction not relieved by simple methods, a preliminary appendicostomy, cecostomy or transverostomy is used. In selected cases an appendicostomy can rapidly be dilated to size 28 F. by successive catheters of increasing size. With a complicated carcinoma a primary eliminative operation is done, the bowel being first divided and united well outside the malignant segment, while the ends of the malignant section are exteriorized for irrigation and later removal of the defunctionalized segment. The Mikulicz-Paul stage operation, insufficiently radical in the sigmoid area, should properly be discarded except to relieve an acute emergency. Anastomosis where the bowel has not been well emptied is best accomplished by a closed anastomosis, for which the Furniss clamp has the advantage of producing only a small inversion of the bowel ends. For diffuse polyposis the colon may be removed in one or two stages, with anastomosis of the ileum to the rectum or lower sigmoid. There is an advantage in doing the stage operation, with primary hemicolectomy and

anastomosis rather than a temporary ileostomy. Rectal anastomoses below the peritoneal reflection are more difficult and more subject to leakage. The abdominoperineal pull-through operation is preferred for carcinoma of the rectum and rectosigmoid situated at least 6 cm. above the anus. Suture anastomosis or the perineal or sacral approach is not approved for the low resections. The bowel is not sutured to the skin, but a 10 cm. segment is left protruding from the split anus for one week. Unnecessary features of the Miles operation in most cases are removal of the pelvic floor, pelvic peritonealization and the formation of a pelvic diaphragm. For growths within 6 cm. of the anus, a wide resection of the pull-through type, with perineal colostomy, is preferred. For carcinoma with ineradicable extension, radical excision is used except in terminal states. A sump drain, used in all large intestinal resections gives the earliest indication of leakage, ileus or other wound complications.

SOMMAIRE

Pour le carcinome du côlon, une large résection de l'intestin et du mésentére avoisinant, suivie d'anastomose bout-á-bout est populaire. L'intestin étant vidé et ayant été aseptisé par l'emploi d'antibiotiques, l'opération avec un ou deux rangs de sutures interrompues nous donne de bons résultats. Quelques operateurs craignant la contamination de l'incision abdominale, adjournent la fermeture de la paroie abdominale. Même pour les anastomoses iléocoliques, l'anastomose bout-á-bout est en train de remplacer l'anastomose latérale. Quand l'obstruction n'est pas soulagée par les méthodes élémentaires, on a recours á l'appendicostomie, á la cecostomie ou á la transverostomie préliminaires. Dans certains cas une appendicostomie permet une dilatation rapide jusqu'á 28 F. par l'emploi successif de sondes de calibre augmentant. Avec un carcinome compliqué, on fera premièrement une opération éliminative, en divisant l'intestin et en l'unissant en dehors du segment malin. Les extrémités du segment malin sont extériorisées pour irrigation et pour enlèvement tardif total du segment malin. L'opération Mikulicz-Paul est insuffisament radicale pour la région sigmoïde et ne sera pratiquée que pour soulager des symptômes très urgents. L'anastomose, quand l'intestin n'a pas été complétement bien vidé, est plus facilement accomplie par l'union fermée pour laquelle le clamp Furniss a l'avantage de ne produire qu'une légère inversion des bouts intestin-aux. Pour la polypose diffuse du côlon, l'opération se fera en deux étapes. On enléve le côlon et on unira l'iléum au rectum ou á la partie terminale du sigmoïde. Il y a un avantage d'opérer en deux étapes une hémicolectonie primaire et une anastomose, plutôt que de pratiquer une iléostomie temporaire. Les anastomoses rectales aü-delá de la réflexion péritonéale sont plus difficiles et sont suivies souvent d'écoulément. L'opération abdominale-périnéale est préférable pour le carcinome du rectum et du recto-sigmoïde situés au-delá de 6 Cm. de l'anus. La suture anastomose ou l'approche périnéal ou sacral, n'est pas approuvé pour les résections basses. L'intestin n'est pas suturé á la peau mais on laisse un segment de 10 Cm. faire saillie á travers l'anus pendant une semaine. Les mesures inutiles dans la plupart des cas de l'opération de Miles, sont l'enlèvement du plancher-pelvique, la péritonéalisation pelvique et la création d'un diaphragme pelvien. Pour les tumeurs ne dépassant pas 6 Cm. de l'anus, une résection large et suivie de colestomie périnéale est préférable. Pour les carcinomes avec extension inéradicable, l'emploi de l'excision très large excepté dans les états terminaux est indiquée. Le drainage employé dans les larges résections intestinales nous donne les premières indications d'écoulement, d'obstructions et d'autres complications de la plaie.

SUMARIO

El tratamiento mas popular del cancer del colon abdominal es la reseccion del segmento afectado con anastomosis directa de los extremos del colon. Con el colon vacio y aseptico por el uso de antibioticos da buenos resultados la sutura del intestino con dos lineas de costura. Ciertos cirujanos por el miedo de que haya contaminacion de la

incision de la pared del abdomen, practican su sutura mas tarde. En casos de obstruccion intestinal que no se puede controlar con metodos mas simples, la apendicostomia o la cecostomia o aun la colostomia del transverso se usa con buenos resultados. En casos seleccionados una apendicostomia se puede rapidamente dilatar hasta obtener un calibre de 28 F, usando cateteres de diferente tamano. En casos de carcinoma complicados el intestino primeramente se divide y luego se une muy por fuera de la seccion invadida por el cancer; mientras tanto este segmento cancerosos es resectado y sus extremidades son exteriorizadas para ser irrigados y con el tiempo se resecta el segmento asi desfuncionalizado.

El procedimiento de Mikulicz-Paul no es sufientemente radical en la cirujia del sigmoideo por lo tanto solo se debe de practicar en las emergencias agudas. La anastomosis de segmentos intestinales que no se pueden evacuar completamente se puede hacer con el uso del forceps de Furniss que tiene la ventaja de producir una pequena inversion de los terminos del intestino. En el tratamiento de la poliposis difusa del colon este se puede resectar en una o dos etapas con anastomosis del ileo al recto o al sigmoideo. Hay ciertas ventajas en ejecutar una hemicolectomia primaria con anastomosis en lugar de una ileostomia temporal. La anastomosis rectal por debajo de la refleccion peritoneal son mas dificiles y hay mas peligro al escape. En el cancer del recto y recto sigmoideo situado por lo menos 6 cms. arriba del ano la reseccion abdomino-perineal con deslizamiento del segmento superior es la operacion mas preferible. El intestino no es suturado a la piel, pero un segmento de 10 cms. de largo se deja que protruda por una semana. Los procedimentos innecesarios de la operacion de Miles, en la mayoria de los casos, son la reseccion del suelo de la pelvis, y la peritonealizacion y formacion de un diafragma pelvico. En cenceres que estan complicados por metastasis o extensiones iradicables, la excision radical se usa, con excepcion de las casos que ya estan en el estado terminal. El uso de un dren en todas las resecciones del intestina largo, dan muy temprano indicaciones de escape, o de la apariencia del ileus o de otras complicaciones de la herida.

RIASSUNTO

L'operazione piu' comune per il cancro del colon e' la resezione dell'intestino e del mesentere adiacente, con anastomosi termino-terminale. Buoni risultati sono stati ottenuti con quest'operazione, avendo svuotato e disinfettato—in anticipo—con antibiotici l'intestino. Pochi chirurghi, nel timore di una contaminazione dell'incisione, ricorrono ad una chiusura secondaria delle pareti addominali. Le anastomosi termino-terminali vanno sempre piu' sostituendosi — anche nelle anastomosi ileo-coliche—alle laterali. Quando i comuni metodi non riescono a superare l'ostruzione intestinale, un'appendicostomia, una cecostomia, od una transversostomia preliminare trovano un'indicazione. In taluni casi un'appedicostomia puo' essere rapidamente dilatata con una serie crescente di cateteri fino a raggiungere un diametro di 28 F. Nei carcinomi complicati e' opportuno ricorrere ad un'operazione preliminare allo scopo di sezionare ed allacciare l'intestino ad una certa distanza dal tumore, esteriorizzando in seguito ed asportando poi in un secondo tempo il segmento colpito.

L'operazione a tappe di Mikulicz-Paul, la quale non e' abbastanza radicale nella zona del sigma, puo' essere eseguita solo allorquando insorga una complicazione acuta.

Nelle poliposi diffuse il colon puo' essere asportato in uno o due tempi, con anastomosi dell'ileo al retto od alla porzione piu' bassa del sigma. Vi e' un certo vantaggio nell'eseguire l'operazione in piu' tempi, con un'emicolectomia iniziale ed anastomosi dell'ileo, piuttosto che un'ileostomia temporanea. Anastomosi rettali al disotto della plica peritoneale offrono maggiori difficolta' e sono piu' facilmente soggette a diffusioni del contenuto intestinale.

L'operazione addomino—perineale e' preferibile nei cancri del retto a del retto-sigmoide situati per lo meno 6 cm. al di sopra dell'ano. Nella resezioni basse, la via perineale o sacrale non e' consigliabile, come non sono indicate le anastomosi con suture.

Surgical Management of Diverticulitis of the Sigmoid*

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WHILE it is generally conceded that a good portion of patients suffering with diverticulitis will respond to nonsurgical management and, further, that the complications of this disease require surgical intervention, there still exists lack of agreement as to the indications for resection. The purpose of this discussion is to review our experience with diverticulitis and particularly to rationalize its surgical management.

Diverticulitis is the term applied to a morbid condition characterized by the presence of sacculations along the extraluminal wall of the gastrointestinal tract, these having undergone inflammatory change. The literature is replete with references to this subject, especially during the past quarter century. As early as 1700, Littre mentioned "Diverticular Hernia" while Riolan, Gunz, Schroch, and Sommerling reported cases at a later date. The first notable description was that given by Cruveilhier in 1849; shortly thereafter published works by Virchow and others appeared. Graser in 1889 emphasized the importance of the disease, while Berr in 1904 gave consideration as to its etiology and classification. In 1907, Moynihan presented a scholarly paper on its mimicry of cancer of the colon. The same year Mayo, Wilson and Griffin reported five cases in which a portion of the sigmoid was excised. An excellent description of peridiverticulitis, its pathology, pathogenesis and complications followed shortly thereafter.

The term diverticulum is derived from the Latin *diverto*, "I turn aside." The suffix, culum, when appended to the verb indicates the diminutive and may be freely translated as "a small turning aside." This aptly describes the condition despite its brevity. The lesions do not assume the characteristics of an independent entity, but appear rather as projections which have "turned aside" for a variable distance from the parent bowel.

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INCIDENCE

These blind pouches may occur at any site, but their greatest incidence is in the large bowel. According to Abel, in 85 per cent of the cases, the site of election is the flexure of the sigmoid colon. Unless otherwise anatomically qualified herewith, diverticulitis is accepted to mean sigmoidal diverticulitis.

The incidence of diverticulosis in all probability will never be accurately determined because many individuals in whom the lesions exist remain in perfect health and are not examined. Consequently, some observers have declared that the presence of diverticula in the intestine is only of academic interest and merits no greater attention than that accorded the uncomplicated appendix or gallbladder. While it must be admitted that diverticulosis is essentially inocuous, recent statistics indicate it to be a potential site of inflammation not to be disregarded. Diverticula of the intestine were observed in 6.9 per cent of a series of 447 cases which came to necropsy at the Mayo Clinic. Roentgenologically, a study of 2,747 cases also revealed the presence of diverticula in the proportion of 7 per cent. The similarity of the statistical result in both these instances precludes a coincidence and may well afford the true incidence.

The transition from diverticulosis to diverticulitis has been variously reported by different authors as from 11 to 35 per cent. In the light of these statistics, it is reasonable to assume that the transition from diverticulosis to diverticulitis may be considered approximately from 20 to 25 per cent.

The sex of the individual does not play as important a role in diverticulosis as was previously believed. Earlier ratings gave a higher incidence in males, but subsequent investigations reduced the ratio to approximate

TABLE 1. AGE DISTRIBUTION OF SIGMOIDAL DIVERTICULITIS.

Age	Cases
21–30	3
31–40	9
41–50	16
51–60	38
61–70	26
71–80	9
81–90	3
Total	104

equality. According to Ochsner, diverticulitis attacks the male more frequently in a ratio of 2.75:1. Similarly, in a series of cases, now asymptomatic, giving a previous history of previous diverticulitis, males again exceeded females, but in a lesser ratio—1.25:1. It is reasonable, therefore, to adopt the working premise of diverticulosis attacking both sexes equally and that only in the presence of diverticulitis and its complications does that balance change to a preponderance of males.

Diverticulitis is generally considered a disease of the latter decades of life, although it has been known to occur earlier. Some clinical observers have reported cases below the age of 50, but none under the thirtieth year. The great incidence of diverticulitis has been established between the ages of 50 and 60, reaching a maximum at 59. Thereafter, a progressive decrease in the number of cases has been observed. In the authors' group, there were three instances occurring between the twenty-first and twenty-fifth year.

It is important, however, to bear in mind that diverticulitis can and does occur in the young. There are references in the literature which report the disease to have occurred in children whose ages ranged from 9 months to 19 years. Probably the youngest case on record is that of an eighteen-hour-old infant. In some of these cases the lesions were situated in locations other than the sigmoid, while in others the process was definitely sigmoidal.

The weight of evidence thus indicates quite clearly that while the majority of cases of diverticulitis occur in the fifth decade of life, there are exceptions to this rule which must not be ignored.

Association of Diverticulitis and Carcinoma. Early observers were of the opinion that diverticulitis was a predisposing factor in the development of carcinoma of the intestine. The prevailing opinion at present is at variance with that belief. Ochsner and Bargen found malignancy of the colon in but 6 per cent of their cases in whom diverticula were known to exist (13 cases). In only 7 of these was malignancy found in the same portion of the colon harboring the diverticula. Rankin and Brown found carcinoma in only 4 out of 227 cases of diverticulitis and concluded that the relationship between carcinoma and diverticulitis was incidental rather than actual. Since both diverticulitis and carcinoma of the intestine occur in the latter decades of life in the majority of cases, it is reasonable to expect some percentage of coincidental involvement either in the same area or remotely situated.

ETIOLOGY

There is no unanimity of opinion as to the exact nature of the factors entering into the development of diverticula of the bowel, although much interest and speculation have centered around their etiology. Under embryologic factors may be included the true or congenital diverticula with traction upon the walls as the bowel in its development grows away from the vessels. Among the factors involved are: (1) Anatomic: narrow bowel lumen at rectosigmoid, horizontal plane, or pelvic sigmoid, consistent with stasis; arrangement of longitudinal bands and lack of complete encirclement; presence of saculations due to shortness of taenia compared to the bowel; defect in circular muscle coat created by entrance and exit of blood vessels; the presence of appendices epiploicae along anterior longitudinal band; distention of the veins by passive congestion. (2) Physiologic: sensitivity of the sigmoid; peristalsis; spasm of circular muscle. (3) Pathologic: adhesions causing traction; diverticula; muscle deficiency as the result of degeneration; atrophic changes; avitaminosis. (4) Physi-

cal: pulsion—increased pressure from within; traction—pulling from without.

At this time when much is being said and written on psychosomatic medicine, it seems expedient to mention that Willey, some two decades ago, stated that he had no doubt but that there was a close relationship between depressing emotions and pathologic change in the large bowel and that, in the creation of the diverticulitis, a sensitive and impassioned temperament was a powerful predisposing factor. Synnott, however, observed diverticulitis rarely occurring among the insane. Willard and Bockus do not believe that diverticula are prone to develop in colons which are the seat of neuromuscular irritability. It is true for the most part that we are dealing with theories, yet there does seem to be sufficient data extant to state that the cause in all probability is a combination of factors due principally to an increased intraluminal pressure—pulsion—and a decreased resistance to the pressure created.

Diverticula are defects whether they are congenital—developing in utero—or acquired—developing after birth. Ordinarily, diverticula are classified as true (congenital), or false (acquired), the former being composed of all the bowel coats, viz., mucosa, submucosa, muscularis and serosa, the latter being devoid of some of these coats, usually the muscularis. The latter impression is almost universal today, representing the accepted classification. Congenital type: Diverticula falling into this category usually are single, occur at birth, possessing all the coats inherent in the parent bowel. An excellent example of this type is the Meckel's diverticulum attached to the ileum approximately 3 or 4 feet above the ileocolic junction. Acquired type: Diverticula of this class are generally accepted to be herniations of the mucosa and submucosa through congenitally weak portions of the bowel wall. These "weak portions" exist at a point where the blood vessels pierce the muscle coats. With this background, an increase in intraluminal pressure is considered adequate as an exciting factor for the initial development of the herniation. The diverticula usually are multiple and, as can readily be seen, are composed merely of mucosa, submucosa and serosa.

The mechanism described by Edwards for the formation of acquired diverticula of the intestine is indeed adequate. He emphasized the "weak spots" in the intestinal wall at the point where the blood vessels gain entrance. He amplified this by pointing out that these vascular outlets become smaller during the period of contraction of the bowel. Conversely, they become larger during the period of relaxation. If contraction of two portions of the intestine occurs with a relaxed segment between them, the bilateral pressure will force the mucosa into the enlarged vascular outlets in the relaxed segment thus producing the initial herniation which may then progress to full diverticula formation.

As the diverticula develop they expand into saclike structures of varying size, but they retain the small point of their origin which acts like a collar. This is an important factor in the subsequent development of diverticulitis. Fecal material enters the sac through the constricted neck and is confined therein by the small opening. The diverticula have no muscular coat and cannot eject the offending foreign material. As a result, the foreign body becomes inspissated and stagnant, soon ulcerating the lining of the sac and sets up an infection assuming either a mild or severe character.

A diverticulum is a bottle-shaped process presenting a narrow neck and body, or sac. In the congenital variety, the wall of the diverticulum is composed of all the layers of the bowel wall, whereas in the acquired type there is a thinning out or absence of the circular muscle layer causing herniation of the mucosa and submucosa through the muscle. The number is variable, ranging from one to several hundred. Ordinarily, they are almost spherical in shape, measuring in diameter approximately 2 mm. at the neck and from 6 to 10 mm. at the body. Diverticula of very large size have been reported. These are to be found from the pharyngoesophageal articulation to the anorectal line, although the sigmoid portion of the colon is the favored site. Approximately 85 per cent of diverticula are found in the descending colon and sigmoid. Infrequently, the rectum is involved, although several cases have been cited.

PATHOLOGY

The pathology of diverticulitis is essentially that of inflammation and infection. Any stage may be encountered, from a mild inflammation to gangrene. Abscess formation, perforation, peritonitis, fistula formation into adjacent organs and obstruction from sigmoiditis and peridiverticulitis may be anticipated. The initiation of secondary inflammatory changes depends upon retention of fecal material in the diverticula. It is axiomatic that this should occur most frequently in the sigmoid because the fecal stream is more solid in that location than elsewhere in the gastrointestinal tract. The most common lesion encountered is an inflammatory process localized in the diverticula. All of the elements of inflammation are present, producing a picture not unlike that seen in acute appendicitis. Additionally, there is a characteristic extension of the inflammatory process for a variable distance in the wall of the bowel. The inflammation may subside under nonsurgical care and undergo resolution or it may progress to abscess formation. The abscess may remain static until relieved by operation or it may rupture. If it ruptures into the lumen of the bowel to which it is attached, adequate drainage may result, with a corresponding spontaneous cure. Should it rupture into the peritoneal cavity, peritonitis with all its attendant complications will result.

Extension of the inflammation into adjacent organs fortunately is rare. The resultant fistula usually involves the urinary bladder due to its anatomic proximity. It may, however, involve a neighboring loop of bowel or it may dissect laterally and forward in the iliac fossa to open ultimately on the skin of the left lateral quadrant of the abdomen. The latter extension is quite rare. The fistulae seen in this location usually follow an operation for drainage of an abscess, particularly when the openings of the diverticula have not been adequately eliminated.

The recurrent type of diverticulitis may follow a previously acute process which had undergone spontaneous resolution, indicating a reinfection of the diverticula. Similarly, recurrence may follow the closure of a colostomy which had previously been established for its cure. For many years a proximal colostomy, usually located in the transverse colon, was considered adequate therapy for acute diverticulitis. This was maintained until all evidence of inflammation had disappeared and sigmoidoscopic examination was normal; the colostomy was then closed. More recently, a fairly large percentage of the cases so treated returned with a recurrence of their diverticulitis. As a result, ultimate reliance is no longer accorded colostomy alone but this procedure is now considered merely a valuable preliminary adjunct to resection.

A predominant feature of chronic diverticulitis is a fibrotic infiltration of the wall of the diverticula and parent sigmoid. As a result, the bowel wall becomes thickened, encroaching on the lumen. Ultimately, complete obstruction may ensue. The fibrosis extends for a varying distance cephalad and caudad to the original diverticula and, in tapering off, produces a sausagelike or spindle-shaped mass, considered to be characteristic of chronic diverticulitis. As such, it is used as an aid in differentiating it from the short, abruptly demarcated lesion of carcinoma, although both may occur coincidentally. Fibrous adhesions not infrequently form around the lesion (peridiverticulitis) and attach themselves to the adjacent viscera. Acute inflammatory processes may form in the fibrotic wall of the bowel or in the mass of adhesions. The likelihood of their rupture, however, is small and they are usually discovered at operation or necropsy.

SYMPTOMS

It is almost universally accepted that uncomplicated diverticulosis produces no symptoms. As a result, a clinical diagnosis is often impossible. Willard and Bockus studied the condition with care and arrived at a syndrome which they believe manifests diverticulosis. The syndrome includes an intermittent diarrhea alternating with episodes of constipation, epigastric pain or distress, flatulence and occasionally generalized abdominal pain. The value of this syndrome remains to be proved. It parallels too closely those symptoms attributable to any unstable colon to be recognized as pathognomonic of

diverticulosis. If these symptoms become more definite, they are probably due to a mild degree of diverticulitis, rather than diverticulosis, since it is manifestly impossible by clinical means to rule out a small, hidden, infected sac. In diverticulitis, the symptoms vary in direct proportion to the severity and extent of the inflammatory process. Pain in the left lower quadrant of the abdomen, low grade pyrexia, slight leukocytosis, flatulence, disturbed bowel function, as constipation and diarrhea, a palpable tender sigmoid, nausea and pneumaturia are the composite cardinal symptoms. In our group of 104 private patients, the following symptoms were noted:

Pain (abdominal)	84	(80.7%)
Constipation	73	(70.1%)
Diarrhea	11	(10.5%)
Constipation alternating with diarrhea	13	(12.5%)
Bleeding	17	(16.3%)
Palpable mass in sigmoid (noted by patient)	20	(19.2%)
Pneumaturia	16	(15.3%)

Pain usually is present in the left lower quadrant and is comparable to the sensation accompanying appendicitis and is a fairly constant complaint. It may vary from a slight discomfort to severe colic. The latter is due to an associated spasm of the bowel musculature. The site of the pain does not always correspond with the location of the maximum diverticular pathology, as revealed by the roentgenogram. It does, however, correspond very often with the points of greatest muscular spasm. As a rule, the pain is characterized as a dull ache in the left lower quadrant which may be referred to the back.

In a study of 104 cases of diverticulitis, 73 or 70.1 per cent gave a definite history of constipation; 11 a history of diarrhea and 13 reported constipation alternating with diarrhea. The symptom-complex, however, is not specific, being too unreliable for pertinent diagnosis.

Fever, chills and leukocytosis are merely indicators of the degree of infection. They occur more particularly in acute diverticulitis and its complications and may be absent in the chronic (fibrotic) form. In the presence of abscess and peritonitis, nausea and vomiting are not uncommon. In obstruction due to chronic diverticulitis, it may appear as a late symptom.

The passage of blood from the bowel in diverticulitis is an inconstant factor. It has been reported in widely separated clinics to have occurred in from 7 to 20 per cent of the cases investigated. The degree of bleeding has varied from slight amounts to massive hemorrhage. Some of our more competent observers ascribe little significance to it, preferring to believe that proctoscopic examination will reveal other causes for the phenomenon. They do admit, however, that bleeding has occurred in some of their cases for which they could find no other explanation despite the most careful study. Other observers, equally competent, have adopted the view that rectal bleeding, while it cannot be accounted for by an associated lesion, should be regarded as a symptom of diverticulitis. The mechanism of the phenomenon is unknown. One report suggested that it may have been due to a ruptured vessel in the thinned wall of a diverticulum. That theory, however, is didactic rather than practical. Our view coincides with that of Linde that, while hemorrhage in diverticulitis is neither a predominant nor constant factor, it would be unwarranted to disregard it entirely. The appearance of mucus in the stools has been noted in a small percentage of cases. It is no more characteristic than the mucus associated with constipation, occurring too infrequently to be endowed with any diagnostic significance.

In most cases of diverticulitis tenderness and rigidity are present in the left lower quadrant directly over the lesion. Occasionally, they may reach their maximum intensity over the area of associated colonic spasm. The degree of tenderness and muscular rigidity is increased with the development of any abscess, becoming generalized in the event of perforation and peritonitis.

Palpation of a tender mass in the left iliac fossa is a fairly reliable sign of diverticulitis, but in approximately 80 per cent of cases no mass can be felt. It is usually sausagelike

or spindle-shaped, immovable and quite tender, and must be differentiated from carcinoma.

There are no specific symptoms to indicate either an imminent or actual fistula into a neighboring loop of bowel. The established fistula usually is uncovered by the roentgenogram or by operation. A fistula into the urinary bladder on the other hand, as a rule will serve premonitory notice of its presence. A history of pain, frequency, burning and nocturia warns of adhesion to the bladder. The passage of flatus on micturition is strong presumptive evidence that a colovesical fistula is present. When the fistula becomes established, the urine will become foul and a progressively severe cystitis develops. The presence of fecal material in the urine has been noted in a few of our cases.

DIAGNOSIS

The diagnosis of diverticulitis is not always simple. The symptoms, already enumerated, vary widely in their intensity and one or more of the signs may be absent. The opaque enema provides the most reliable means of establishing a diagnosis. Eggers has stated that "the most valuable symptom is to bear a diagnosis of diverticulitis in mind." Rosser's diagnostic formula is apt: A combination of low-grade pyrexia, tenderness in the left lower quadrant with or without the presence of a palpable mass, and sigmoidoscopic evidence of fixation of the lower colon, especially in an individual over fifty, are indications that careful radiographic studies of the colon are in order. In recent years, more frequent and efficient use of the sigmoidoscope has yielded considerable diagnostic information. A group of signs has been evolved for the recognition of diverticulosis and diverticulitis which has proved of value. Through a consideration of certain signs Buie found it possible to diagnose the lesion in 66 per cent of his cases. The signs are: (1) Limited mobility of a segment of the bowel associated with limited mobility of the adjacent structures. (2) Angulation of the bowel. When present, this feature occurs at the point where the inflammatory process immobilizes the colon and it is practically impossible to pass the instrument beyond it. (3) Reduced lumen and adherent mucosal folds. The former is due to contracture of the fibrous tissue which has infiltrated the wall of the bowel. It follows inevitably that, as the contraction progresses, the mucous folds are crowded together and become adherent. It is not unusual for the folds to become edematous. (4) Sigmoidal sacculations. These are represented as shallow pouches or depressions which may extend partially or completely around the wall of the bowel. In a mobile sigmoid which bears no evidence of inflammatory disease, ridges separating the pouches can often be seen. They may represent a prediverticular state and are best visualized when the bowel is distended with air. A similar observation was made 20 years prior by Spriggs and Marxer. They studied a large series of roentgenograms of the colon and described a "prediverticular state" in which normal segmentation of the bowel was replaced by a "ragged outline of little convex irregularities." (5) Actual view of the openings of the diverticula through the sigmoidoscope. While these signs may be seen separately, they usually occur in combination. It may not be possible to make a definite diagnosis by use of them alone, except when the diverticula are actually visualized. The barium enema is the most accurate and effective agent of diagnosis at our disposal. Its greater use today is responsible for the markedly increased number of patients in whom the lesions are now demonstrated. While the opaque meal may show the diverticula in the colon, it is not as efficient as the opaque enema. Consequently, the barium enema is now used almost universally, either alone or followed by injection of air. The latter, or double-contrast method, is preferable, in that it gives the diverticula a more positive outline.

It is of vital importance, however, to realize that the opaque enema is not infallible. By reason of spasm or orificial constriction, the barium may not enter the sacs and a negative report will result. If the symptoms persist, reexamination should be insisted upon. It is equally vital to realize that a roentgenogram in one position may fail to visualize the lesions, while another angle may demon-

strate them with great clarity. The most effective routine should include anteroposterior, left oblique and right oblique views. In the prediverticular state, the roentgenogram will usually show replacement of the normal segmentation of a small portion of the sigmoid by a unilateral, ragged, irregular, sawtooth marginal outline. In the same film, all of the stages of diverticulosis may be demonstrated. Larger sacculations may be clearly visualized and assume widely divergent shapes and groupings. Some appear round, others ovoid and still others semiglobular. They may occur singly or in oddly-patterned groups. They may appear as a chain of opaque dots in a double row, connected with the lumen of the bowel by short, narrow necks. When fecal concretions are present, the barium will fill the sacs around the foreign body and produce a variety of shapes, such as crescents and fingerlike shadows. The deep indentations of the bowel haustra indicate spasm and are interpreted as evidence of the existence of a prediverticular state of irritability due to an associated inflammatory process. In the chronic obstructive type with tumor formation, a filling defect simulating carcinoma may be visualized. The differential diagnosis is often difficult and on occasion cannot be made with any degree of certainty. According to Feldman, there are few roentgen signs that may give the clue to the true nature of the condition. (1) The mucosal relief view of the colon does not show as complete destruction of the mucosa in diverticulitis as is found in carcinoma. (2) The picture in malignancy is constant while in diverticulitis the defect as well as the tumor has a tendency to change. (3) In diverticulitis the obstruction usually is incomplete and occurs as a late manifestation. (4) The defect in diverticulitis as a rule is fusiform or spindle-shaped and is longer than the short, abruptly demarcated lesion of carcinoma.

Not infrequently the rising column of the opaque enema may be seen to halt abruptly and no more of the solution can be introduced. The presence of an obstructive lesion is apparent but a differential diagnosis from the film is impossible. A roentgenogram following the oral administration of barium would probably yield invaluable information, but such is a dangerous practice because it may aggravate the existing obstruction. For this reason, an opaque meal is never utilized in the presence of an impending obstruction. In recent months, however, Wyatt has developed a technic for the oral administration of barium which he feels eliminates this danger. By adding magnesium citrate, he has been able to produce an opaque medium which will maintain its liquid state permanently. As a result, its administration orally does not result in impaction proximal to the lesion. This method has been employed by Dr. S. A. Linde in several cases with gratifying results.

Colovesical and enterocolic fistulae may be visualized by the passage of the opaque solution from the sigmoid into the adjacent loop of bowel or into the urinary bladder. The tracts are not always distinct, particularly in the enterocolic variety. In the colovesical fistula, the more common of the two, the tract is more easily visualized by cystoscopy, cystography, using indigo carmine, and sigmoidoscopy.

PROGNOSIS

The prognosis in diverticulosis is uniformly good. While most of these cases remain asymptomatic, approximately 15 per cent will suffer the transition to diverticulitis. When this occurs, the prognosis will become progressively worse in direct proportion to the severity and extent of the inflammatory process. Extensive surgery which may be required provides an additional prognostic risk.

TREATMENT

The treatment varies with the type and degree of inflammatory involvement. In diverticulosis and uncomplicated diverticulitis the management is medical, designed toward keeping the diverticula empty. A bland, nonirritating diet free of residue is advocated. All fruits containing seeds should be avoided. Rough, raw or stringy vegetables are similarly interdicted. Fish should be filleted and all bones carefully removed. If constipation becomes troublesome as a result of the diet, fruit juices may be consumed

in more liberal quantities. Alcohol may be used in moderation.

There is common agreement that a good portion of patients suffering with diverticulitis will respond to nonsurgical means. Too, there is little diversity of opinion that the complications of this disease require surgical intervention. Of these may be mentioned peridiverticular abscess, perforation, fistula and obstruction. More than occasionally it is impossible to distinguish between malignancy and diverticulitis, for which reason exploration under such circumstance is justifiable.

It is recognized that the establishment of a stoma proximal or orad to the involved segment of bowel is followed by improvement of the symptomatology as a result of subsidence of the inflammatory process. This amelioration of symptoms may be but temporary and of varying degree. The desire of patients for closure of their colostomy often becomes a troublesome problem and frequently it is difficult to convince them that closure should be postponed. Certainly, several months should be permitted to elapse before closure is contemplated. During this period, irrigation through a completely inactivated bowel should be instituted and antibiotic and chemotherapeutic measures employed.

Unfortunately, there exist no definite criteria by which one may determine the precise time closure should be effected, or when there is no danger that recurrence of symptoms will develop. Ordinarily, closure may be considered reasonably safe after the patient has been completely symptom-free for a period of several months and regression of the process with restoration of continuity has been observed by roentgenologic and sigmoidoscopic examination. It is worthy of mention that in Pemberton's series, satisfactory relief followed closure of the colostomy in less than one-third of the cases.

Removal of the diseased segment of bowel is, in our opinion, indicated when symptoms recur following complete proximal defunctionalization and despite the use of sulfonamide and antibiotic therapy. Also, resection should be performed when fistula exists or when malignancy is suspected. While patients with sigmoidal diverticulitis and its concomitant complications must be studied individually, no single procedure can be selected arbitrarily which will meet the requirements of every case. The exteriorization operation designed by Mikulicz and modified by Rankin will be found applicable in most cases. During the past decade there has been a definite trend toward resection with immediate establishment of continuity. While such an operation alone serves to eliminate much of the invalidism associated with multiple-stage procedures, there is seldom an instance where it can be employed without risk, unless defunctionalization has been instituted previously.

Complications. Peridiverticular abscess is by far the most common complication. Laparotomy and drainage is conservative and at the same time usually satisfactory. Any attempt to exteriorize the involved segment invites additional risk and is not to be recommended. Acute perforation into the peritoneal cavity demands immediate operation. Ordinarily, a left inguinal muscle-splitting incision will provide adequate exposure. The perforation should be located and closed. While it is true that in many instances small perforations become sealed spontaneously, the larger ones do not. Consequently, obliteration of the perforation is the more rational procedure. If the opening of the diverticulum cannot be located in the inflammatory mass, a flap of omentum may be sutured over the area most likely to contain it. A Babcock metal sump drain or other suitable drains should be placed in the left lateral iliac gutter in the pelvis or in both sites. In two instances, we resigned ourselves to the more conservative measure of introducing a Babcock drain beside the perforated area. Both healed spontaneously. The simultaneous establishment of a transversostomy is advocated.

Extension of the inflammatory lesion of diverticulitis into an adjacent organ, usually the urinary bladder, is a serious complication. Fortunately, however, it is not too common. The treatment of sigmoidovesical fistula is surgical. The establishment of a proximal double-barrel colostomy is a short-circuiting procedure that is justifiable. This is especially

true in the presence of associated abscess formation, where several unrelieved symptoms which are severe, and pertinent to the bladder exist, and as a preliminary stage to resection. In performing the colostomy, it is important to separate the two loops of bowel in order to prevent "spill-over" of the intestinal content. Cave and others recommend diversion of the fecal stream prior to removal of the involved segment with its adjacent fistula. Our usual plan is to establish a transversostomy of the Wangensteen or Devine type. Following a period of daily irrigation with sulfathalidine in suspension form through the lower (distal) loop to permit the inflammatory process to subside, resection is performed. Urethral drainage is instituted prior to resection, while suprapubic drainage is established at the time of resection. The Mikulicz procedure of exteriorization is an ideal method along with cystectomy. We are convinced that an immediate end-to-end anastomosis and cystectomy is unnecessarily formidable and therefore a poor choice.

Obstruction calls for bed rest and the parenteral administration of fluids. If small bowel distention supervenes, intestinal intubation should be instituted. In the presence of acute colic obstruction, surgical decompression is indicated. Our choice has been appendicostomy or cecostomy, while in chronic obstruction a transversostomy is preferred.

Operation. In our group of 104 patients with diverticulitis, 32 were submitted to operation.

TABLE 2. OPERATIONS EXCLUSIVE OF RESECTION.

Operation	Cases	Deaths	Mortality Per Cent
Colostomy for obstruction	5	1	20.0
Incision and drainage of abscess	3	1	33.33
Drainage for perforation without closure	2	0	0
Exploration only	1	0	0
Total	11	2	18.1

Resection was performed in 21 instances. Proximal colostomy of the defunctionalizing type (Wangensteen or Devine) usually had been established at a suitable time prior to resection.

Six operations were performed by the exteriorization method of Mikulicz, three by abdominoperineal proctosigmoidectomy, and six by resection followed by end-to-end anastomosis. In six patients, sigmoidectomy with permanent colostomy and extraperitonealization of the closed rectal stump (Hartmann technic) was instituted. Partial cystectomy was required in four instances.

TABLE 3. RESECTION.

Type of Resection	Cases	Deaths	Mortality Per Cent
Exteriorization (Mikulicz)	6	0	0
Abdominoperineal proctosigmoidectomy	2	0	0
Abdominoperineal proctosigmoidectomy with hemicolectomy	1	0	0
Resection followed by primary end-to-end anastomosis	6	1	16.6
Anterior resection with colostomy and exteriorization of closed rectal stump with concomitant partial cystectomy in four	6	0	0
Total	21	1	4.7

SUMMARY

One hundred and four cases of sigmoidal diverticulitis were treated by the authors; of this number, 32 were submitted to surgery. Resection was performed in 21 cases with one death, a mortality rate of 4.7 per cent. Of the major surgery performed 6 were by the exteriorization method of Mikulicz; 3 by abdominoperineal proctosigmoidectomy and 6 by resection followed by end-to-end anastomosis. In 6 others, sigmoidectomy, with permanent colostomy and extraperitonealization of the closed rectal stump by the Hartmann technic was instituted. Partial cystectomy was required in 4 instances. It is our opinion that prior to surgical intervention each patient must be carefully individualized, par-

ticularly in relation to the procedure best suited to his or her case.

SOMMAIRE

L'auteur a traité 104 cas de diverticulité sigmoïdale; de ce nombre, 32 furent soumis a un traitement chirurgical. On fit la résection dans 21 cas. Il y eut un décès qui une mortalité de 4.7%. Dans 6 cas, on employa la méthode d'extériorisation de Mikuliez; dans 3 cas, on pratique la proctosigmoidectomie et dans 6 cas on fit une résection suivie d'anastomose bout-à-bout; dans 6 autres cas, on pratiqua une sigmoïdectomie avec colostomie permanente et occlusion extrapériténéalle du rectum. La technique d'Hartman fut instituée. La cystectomie partielle fut pratiquée dans 4 cas. Nous sommes d'avis qu'avant d'intervenir chirurgicalement, chaque malade doit être individualisé particulièrement afin de mieux choisir le procédé le mieux adapté a son cas.

RIASSUNTO

Gli AA. hanno trattato 104 casi di diverticolite del sigma. 32 casi sono stati sottoposti ad un intervento chirurgico. In 21 e' stata necessaria una resezione dell'intestino, con un caso di morte (4,7%). 6 casi sono stati sottoposti ad un'esteriorizzazione col metodo di Mikulicz. In 3 e' stata eseguita una proctosigmoidectomia addomino — perineale. In 6 una resezione seguita da un'anastomosi terminale. In altri 6 casi una sigmoidectomia, con colostomia permanente ed extraperitonealizzazione del moncone rettale, chiuso secondo il metodo di Hartmann. In 4 casi si e' resa necessaria una cistectomia parziale.

Gli AA. giungono alla conclusione che ogni paziente va esaminato accuratamente prima dell'operazione, specialmente per quanto riguarda la procedura piu' indicata ai singoli casi.

SUMARIO

Los autores han tratado 104 casos de diverticulitis del colon sigmoideo; de los cuales 32 casos fueron operados, 21 de los casos fueron tratados por la reseccion con una muerte, o sea 4.7% de mortalidad. De estos casos 6 fueron tratados por el metodo de esteriorizacion de Mikulicz; 3 por la proctosigmoidectomia abdomino-perineal; y 6 por la reseccion del segmento afectado con anastomisis de termino a termino. En otros 6 casos, se practico la sigmoidectomia, con colostomia permanente y extraperitonealizacion del segmento rectal de acuerdo con la tecnica de Hartmann. En 4 casos fue menester el practicar la cistectomia parcial. En nuestra opinion el tratamiento quirurgico de la diverticulitis del sigmoideo debe de ser individualizada, es decir que es menester el seleccionar el procedimiento quirurgico en relacion con cada caso.

Mortality Factors in Acute Intussusception in Infants and Children*

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SINCE acute intussusception is the most common cause of intestinal obstruction in infants and children, factors governing the mortality of this condition may well be emphasized from time to time. We believe that this can best be done by contributing to the literature studies of larger series of patients with acute intussusception and by comparing such studies with similar studies made by authors from other similar institutions.

Our studies are based on an analysis of 95 patients previously reported by us [1] and on an additional 12, making a total of 107 infants and children that were admitted to the Cook County Children's Hospital during a 23-year period from 1925 to 1947 inclusive. Approximately 68 per cent of these patients were under one year of age, 21 per cent were between 1 and 2 years, 8 per cent were between 2 and 3 years and 3 per cent were 3 years or over. The youngest in our series was 2 weeks old and oldest 15 years of age. All the operations were performed by the various members of the surgical staff.

In comparing our studies with similar studies reported in the literature it is not our object to present a complete review of the literature but simply to select a limited, fairly representative number and employ them for purposes of comparison (Table 1).

Some of the more significant mortality factors in acute intussusception are considered in the following discussion.

Age Considered as a Mortality Factor. Since intussusception is primarily and peculiarly a disease of infants and children, one might question whether age should really be considered in this category. It may be stated generally that with all things being equal, infants under one year of age sustain a higher mortality rate than infants between one and two years of age regardless of the type of surgery. In our series, however, just the reverse was true. Yet when it comes to children over 3 years of age the mortality is definitely lower and consequently age does become a factor in mortality.

Types of Intussusception. In order to avoid confusion in designating the various types of intussusception, we have become quite partial to the classification suggested by Nyborg,[5] who divides them into three groups: (1) Those occurring at the boundary between the small intestine and colon (ileocecal, ileoileocecal, ileocolic, and ileoileocolic). (2) Those occurring in the ileum alone. (3) Those occurring in the colon alone. From a study of our series those occurring at the boundary between the small intestine and colon sustained the highest mortality, while those involving either the ileum alone or colon alone had a much lower mortality. Perrin and Lindsay reported similar findings. On the contrary, Hogg and Donovan and Gibbs and Sutton noted their highest mortality in the ileoileal group and their lowest rates in the group involving the boundary between the small intestine and the colon. It seems apparent, therefore, that the type of intussusception has no constant material effect upon the mortality rate.

Progression of the Intussusception. Ladd and Gross noted in their studies that the farther the intussusception advanced the higher the mortality. Similar findings were reported by Hogg and Donovan. In our studies, however, this was not fully borne out. In 87 of our patients whose intussusceptions were palpable on physical examination the highest mortality of 19.0 per cent occurred in the group in which the intussusception was palpable in the right upper quadrant. The lowest mortality of 8.3 per cent occurred in the group in which the intussusception was palpable in the right lower quadrant, while

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TABLE 1. COMPARATIVE MORTALITY BY DURATION OF SYMPTOMS.

Authors	Total Cases	Duration of Symptoms in Hours							
		0 to 24		25 to 48		49 to 72		Over 72	
		Cases	Mortal. %	Cases	Mortal. %	Cases	Mortal. %	Cases	Mortal. %
Ladd and Gross [2]	484	234	8.5	118	42.3	52	42.3	80	65.0
Gibbs and Sutton [3]	86*	38	10.5	19	15.8	6	33.3	23	63.2
Musil [4]	105	44	0.0	27	26.0	34	32.0	..	....
Oberhelman and Condon [1]	107†	50	2.0	21	14.2	21	38.0	14	50.0

* Not including 6 in which history was not obtained.
† Including 1 in which history was not obtained.

the mortality for the left upper quadrant, left lower quadrant and the epigastrium were 9.1 per cent, 10.0 per cent and 16.6 per cent respectively. Furthermore, in this connection it should also be noted that we found no evidence to support the notion that the longer the symptom period the more caudad the intussusception. As a matter of fact, the average symptom period of those whose intussusception was palpated in the epigastrium was 49.7 hours compared to an average of 25.1 hours for those appearing in the more caudad left lower quadrant. We are inclined to the view that a mobile cecum and ascending colon having a long mesentery play a more prominent role in the matter of distance traveled by the intussusception than that played by the duration of the symptom period.

Duration of the Symptom Period. Without doubt, the duration of the symptom period is the most significant single factor in the mortality rate of acute intussusception (Table 1). If treatment is instituted during the first 24-hour period after onset, whether reduction be accomplished by surgery or by hydrostatic measures, the mortality will be low. In our series there was but one death in 50 patients. Obviously, this represents the period before complications set in. Should the delay in instituting treatment exceed 24 hours the mortality rises promptly and progressively (Table 1). Clearly, this represents the period when serious complications are ushered into the picture. Dehydration from vomiting and lack of fluid intake, signs of intestinal obstruction, acute peritonitis and shock comprise the group of complications that increase, so materially, the risk in any type of surgical therapy.

Signs and Symptoms of Shock. In our series there were 36 patients admitted in varying degrees of shock. On close analysis, two types of shock were noted, each with an apparently different causative factor. In the first type the patient had a short symptom period whose shock syndrome could best be explained on the basis of a sudden onset, the severity of the pain and the probable traction on the root of the mesentery. There were 22 patients in this category and all made uneventful recoveries following simple manual reduction by operation. In the second type the patient had a long symptom period whose shock syndrome was explained on the basis of vomiting, dehydration, intestinal obstruc-

TABLE 2. COMPARATIVE MORTALITY RATES FOR RESECTION IN INTUSSUSCEPTION.

Authors	Year	Resections		Total Mortal. %
		No.	Mortal. %	
Perrin and Lindsay [6]	1921	49	81.6	34.7
Close [7]	1931	18	94.4	35.4
Robbins [8]	1932	4	50.0	35.3
Ladd and Gross [2]	1927–1939	43	76.6	26.9
Woodhall [9]	1938	6	50.0	
Gibbs and Sutton [3]	1943	14	71.5	30.4
Hogg and Donovan [10]	1946	9	55.5	13.0
Oberhelman and Condon [1]	1948	16	37.5	16.9

tion and toxemia. There were 14 patients suffering from this type of shock and regardless of the method of therapy the mortality was exceedingly high. Surgical measures, other than simple manual reduction, were necessary for relief in this group.

Irreducibility of the Intussusception Requiring Surgical Measures. Any additional surgical procedure, when simple manual reduction cannot be accomplished, at once raises the mortality. As the symptom period increases the chances for a simple manual reduction decreases. Resection or some modified form of surgical procedure then becomes imperative to relieve the obstruction. In our series 16 patients whose average symptoms period was 71.3 hours required such additional surgical measures with a mortality of 37.5 per cent (Table 2). Any particular type of operative procedure in this series had little or no advantage over another. Nevertheless, we feel that the Lahey-Mikulicz method is the operation of choice for resections of the right colon and terminal ileum. For resections of either the ileum or colon alone a primary resection with end-to-end anastomosis is useful. The so-called "short circuiting" operation without resection of the irreducible mass first employed by Rutherford [11] in 1906 has considerable merit and probably should be employed more often. It was used successfully in two patients in the irreducible group.

Meckel's Diverticulum. Is Meckel's diverticulum a mortality factor? Gibbs and Sutton found a Meckel diverticulum in 2 of their 92 patients, both requiring resection with a mortality of 50 per cent. Ladd and Gross encountered such a diverticulum in 14 of their 484 patients with a mortality of 59.0 per cent. In 123 patients reported by Hogg and Donovon, 4 had Meckel's diverticulum but these authors made no mention of their mortality, nor do Perrin and Lindsay make mention of the mortality among their 4 patients with Meckel's diverticulum in 400 patients. In our series of 107 patients Meckel's diverticulum was encountered in 6 patients, of which 4 required resection with a mortality of 50 per cent. It is interesting to note how rarely Meckel's diverticulum was encountered by Perrin and Lindsay, and how frequently it was encountered in our series, namely 1 per cent and 5.6 respectively. We have no explanation to offer for this wide difference, but it can be stated that from the standpoint of our experience Meckel's diverticulum may be overlooked whether involved or not in the intussusception. This occurred in one of our patients who had developed a recurrence and in whom Meckel's diverticulum was found at the second operation but overlooked at the first operation. In view of the fact that the mortality of those with Meckel's diverticulum is invariably higher than that found in the rest of the series, it must be considered a mortality factor, although it need not be considered a seriously threatening menace.

Recurrences. It is interesting to note that

according to Table 3 recurrences play little or no part in the mortality of acute intussusception. According to statistics, approximately 3 per cent have a recurrence making the incidence very low. If the recurrence does not develop too soon after the first operation and all other factors are equal, the risk of a second operation is no more hazardous than the first. If the recurrence develops before the patient has fully recovered from the first operation, the second operation may carry a slightly greater risk. But one patient in our series developed a recurrence on the third postoperative day and was reoperated on the fourth postoperative day with an uneventful recovery.

TABLE 3. INCIDENCE AND MORTALITY OF RECURRENCES.

Authors	Cases	Recurrences		
		Cases	Deaths	Mortal. %
Ladd and Gross	484	10*	0	0.0
Close	363	14	Not Mentioned	
Hogg and Donovan	123	4†	1	25.0
Oberhelman and Condon	107	4‡	0	0.0
Gibbs and Sutton	92	3	0	0.0
Total	1169	34	1	5.0

* One patient and 4 recurrences.
† One had 3 recurrences.
‡ One had 2 recurrences.

Complications. Of the 19 patients dying in our series, three were moribund and died shortly after admission to the hospital; 5 died on the operating table, 3 having required resections; 5 died in less than 9 hours postoperatively from shock and 6 died from one to eight days after operation from peritonitis. These fatal complications, one can readily see, were the direct result of the intussusception itself, and when such complications arise, surgery is the only hope and that often ends in failure. In the 88 recovering from surgery, only 10 had surgical complications. Evisceration occurred in 3 patients, bronchopneumonia in 4, wound infection in 2 and intestinal obstruction in one.

Inadequate Preoperative, Operative and Postoperative Care. The importance of adequate preoperative, operative and postoperative care cannot be overemphasized. The higher mortality rates indicated in some of the earlier reports (Table 2) may well be attributed to the lack of some of the more recent aids to surgery such as chemotherapy, the antibiotics, plasma, blood and the continuous Wangensteen suction. The advantage of having both the pediatrician and the surgeon share the responsibility equally is immense. We feel that regardless of how urgent surgical intervention may be, it is of distinct advantage to delay any surgery long enough to permit at least some restoration of the fluid and electrolyte balance by the intravenous administration of glucose and saline solutions augmented by plasma and blood transfusions. By maintaining the administration of one or other such fluids during the operation as well as during the immediate postoperative period many patients recover who otherwise would terminate fatally in spite of the finest surgical technic. It is common knowledge, however, that since these improved facilities have been available and made use of, the overall reduction of the mortality has been most gratifying. This is clearly evidenced by the overall mortality of 5.2 per cent for the last 57 consecutive cases in our series.

Conclusions. Various factors that play a part in the mortality in acute intussusception have been discussed. The greatest single factor in this mortality is the duration of symptom period. If the symptom period exceeds 24 hours complications appear and as the symptom period increases thereafter the most effective methods of treatment become progressively less effective. The greatly improved preoperative, operative and postoperative program shared in equally by the pediatrician and surgeon has greatly aided, however, in a progressive lowering of the mortality rate. Aside from an occasional unexplained death following surgery, the mortality would be reduced to a minimum if treatment could be instituted within the first

24 hours. By educating the public to consult the physician early and by stressing early diagnosis by the physician, a "new low" in the mortality of acute intussusception may be anticipated in the near future.

SUMARIO

Se han discutido los factores contribuyentes a la mortalidad en la intususcepcion aguda. El factor singular mas importante es la duracion del periodo simtomatico. Cuando este excede mas de 24 horas, las complicaciones aparezen y contra mas dura el periodo simtomatico menos efectivo sera el tratamiento. Sin embargo, el mejoramiento del regimen preoperatorio, el procedimiento quirurgico y el tratamiento post-operatorio, con coperacion del sirujano y pediatrista ha hayudado a disminuir considerablemente la mortalidad; esta aun seria mucho mas minima se en tratamiento se instituye en las primeras 24 horas. Solo con la educacion del publico de recurrir a tiempo al medico y ensenandole al ultimo la importancia del reconocimiento de esta condicion quirurgica se podra solo asi disminuir aun mas la mortalidad que acarrea la intususcepcion aguda.

SOMMAIRE

Différents facteurs déterminant la mortalité de l'intussusception aiguë sont discutés. Le facteur le plus important dans la mortalité est la durée des sypmtômes. Si les symptômes ont duré plus de 24 heures, des complications surviennent et augmentent la mortalité. Les traitements tardifs échouent le plus souvent. Mais le programme moderne améliore grandement les résultats et contribue à abaisser la mortalité.

Des cas exceptionnels, exceptés la mortalité des cas d'intussusception traités chirurgicalement est réduite au minimum quand on intervient dans les premières 24 heures. Il faut recommander les malades de consulter leur médecin au début des douleurs. Le diagnostique précoce de l'intussusception aiguë permettra d'atteindre une nouvelle diminution dans la mortalité de cette affection.

RIASSUNTO

Dopo avere discusso l'influenza di svariate condizioni che contribuiscono alla mortalita' per intuscezione acuta dell'intestino, l'A. conclude che la percentuale di mortalita' dipende principalmente dalla durata dei sintomi. Se il periodo di attesa supera 24 ore, entrano infatti in scena delle complicazioni, che rendono poi vane le cure piu' diligenti. Educando il pubblico a consultare subito il medico, ed istruendo il medico a porre una diagnosi precoce, e' molto probabile che la mortalita' subira' una notevole diminuizione.

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Palliative Operations for Unresectable Carcinoma in the Pancreatoduodenal Region

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CARCINOMA of the pancreas accounts for 3 per cent of all cancer deaths. Carcinomas of the ampulla-papillary region constitute slightly over 1 per cent of all carcinomas.[3] When it is recalled that about two-thirds of pancreatic carcinomas occur in the head of the pancreas, it becomes evident that over 2 per cent of *all* cancer will be found in this relatively small area centered in the concavity of the duodenal loop.

Since 1935, when Whipple and his associates[4] described a procedure for resection of the pancreas and duodenum, much attention has been given to the development of new procedures and modifications of the original technic for pancreatoduodenal resection.

The resectability rate of tumors in this region is reported to be from 25 to 30 per cent.[1] Review of the cases of pancreatic and ampullary carcinoma coming to surgery at the Wesley Memorial Hospital does not indicate a resection rate over 10 per cent; 75 per cent are pancreatic carcinoma, which in general tends to show earlier local extension and distant metastasis than does ampullary carcinoma. This distribution in part may account for the low resection rate. The evaluation of these tumors on the basis of their potential curability, rather than their mechanical resectability, may account for the remaining discrepancy. It is possible that the *net* gain in terms of more months of life for more patients would be increased by subjecting fewer of these poor risk patients to extensive surgical procedures in the presence of disease grossly advanced beyond the limits of curability.

Regardless of the attitude of the individual surgeon, the fact remains that at least three out of four patients with pancreatoduodenal carcinoma are going to have disease which has extended beyond the limits of resectability and curability. It seems worth-while, therefore, to discuss some of the problems encountered in the management of this larger group of patients presenting advanced lesions.

The importance of careful choice of palliative procedures is emphasized by the evidence that these patients are frequently subjected to reoperation for relief of progressive involvement not anticipated at the initial operation. One patient in every three has more than one palliative surgical procedure. Repeated hospital admissions are the rule rather than the exception for these patients. Those in the group under consideration averaged two hospital admissions each, though only one-fourth of them died in the hospital.

ANATOMIC FACTORS INFLUENCING OPERABILITY

The anatomic position of the head of the pancreas allows but little extension of malignant tumors before invasion of adjacent structures renders the lesions inoperable.

If the curvature of the pancreas and duodenum in the frontal plane is ignored, the tissue block composed of the first three portions of the duodenum and the pancreatic head may be considered as a retroperitoneal rectangular solid presenting six surfaces.

The anterior surface is traversed by the base of the transverse mesocolon. Extension between its layers tends to shorten the mesocolon and frequently involves the colic vessels.

The hepatoduodenal ligament and components of the hepatic trinity are involved by upward extension.

Posteriorly, invasion of the mesenteric vessels, portal vein, inferior vena cava, lumbar vertebral bodies, or aorta occurs and renders these neoplasms not only unresectable, but often dangerous to manipulate.

Inferiorly, involvement of the superior mesenteric vessels is the most frequent extension precluding resection.

Lateral extension to the right or left is least liable to produce early inoperability, as involvement of the second portion of the duodenum or the body of the pancreas will not greatly alter the resection to be done.

DETERMINATION OF UNRESECTABILITY AT TIME OF OPERATION

Unresectability is determined by findings which fall into two groups: those which are evident on gross inspection, and those determined only by dissection to expose areas of extension not visible on first inspection.

Gross indications for palliative procedures only are:

1. Widespread peritoneal metastases.
2. Hepatic metastases.
3. Obvious extension of the lesion beyond limits of resection.
4. Immobility of the lesion, indicating posterior fixation.

Steps in dissection to reveal unresectability:

1. Kocher's maneuver to mobilize the duodenum and head of the pancreas. This will reveal posterior fixation not previously evident.
2. Division of gastrohepatic and gastrocolic omentum permits inspection of the superior mesenteric vessels and the portal vein. Involvement of any portion of these vessels precludes the possibility of resection.

CHOICE OF PALLIATIVE PROCEDURES

Once the hope of resection is abandoned, one must choose palliative procedures which will relieve the patient's present and potential symptoms with the least risk of operative mortality. Palliative measures should be simple and involve a minimal number of anastomoses, as the very extent of their disease makes these patients poor surgical risks.

The most frequent problem encountered is that of short-circuiting the biliary tract to relieve jaundice and its associated phenomena. Seventy per cent of the inoperable cases had jaundice as a presenting symptom.

Cholecystgastrostomy need be mentioned only to be dismissed as an unphysiologic procedure. Bile will not flow from the biliary tree into a viscus (in this case the antral portion of the stomach) in which the pressures normally obtaining are *higher* than pressure in the bile passages.

Cholecystduodenostomy at the first, or junction of the first and second portions of the duodenum, is the simplest procedure available. The operation may be open to some criticism as a permanent short-circuiting method in nonmalignant conditions, but it has proved entirely adequate for the rather short expectancy (five to 16 months) in these cases. It is not indicated where there is actual or impending obstruction of the duodenum.

Cholecystjejunostomy is the next procedure of choice. Enteroenterostomy between the afferent and efferent limbs of the jejunum may or may not be necessary. This has been employed one-third as often as cholecystduodenostomy in the Wesley Memorial Hospital series, and has given comparable results.

Obstruction of the duodenum is a surprisingly frequent complication (15 per cent) in carcinoma of the pancreatoduodenal region, and is responsible for 28 per cent of second palliative operations. It is worth-while to note that obstruction tends to occur at the angles between the portions of the duodenum. Gastroenterostomy should be considered at the time of initial operation if there is a history of nausea, epigastric distress, upper abdominal distention, and vomiting. Succussion sounds are easily elicited in malignant duodenal obstruction. Roentgen examination fails to show early changes in the duodenal lumen, but the angles between the portions of the duodenum should be observed with particular care. The onset of obstruction is insidious and distressing. The patients seem to tolerate their nausea and sensation of fulness well for periods up to 24 hours, only to regurgitate 2 to 3 liters of retained food and gastric secretions. Posterior gastroenterostomy is indicated unless there is invasion of the mesocolon with shortening and thickening. If done in conjunction with cholecystjejunostomy, an antecolic anastomosis is employed.

Obstruction of the pancreatic duct is of least importance in producing the patient's symptoms. The endocrine function of the pancreas is not disturbed, and oral administration of pancreatic extract appears effective in relieving residual gastrointestinal complaints. In the event that the pancreatic duct is dilated and palpable, employment of

the T-tube pancreatojejunostomy as advocated by Cattell [2] appears feasible, although we have not observed its use.

SUMMARY

1. In the midst of current interest in extensive resections of the pancreas and duodenum for malignancy, it is well to recall that the majority of patients with pancreatoduodenal carcinoma will be candidates for palliation only.

2. Incidence of reoperation and rehospitalization of these patients with inoperable carcinoma indicates that initial palliative operations are often inadequate.

3. The anatomic limitation and clinical determination of resectability are described briefly.

4. Palliative surgical steps are outlined. Attention is directed to the relative frequency of duodenal obstruction as a distressing complication and indication for reoperation.

SOMMAIRE

Dans la résection étendue du pancréas et du duodénum pour maladies malignes, il est important de se rappeler que la majorité des malades souffrant de carcinome pancréatique sont des candidats seulement pour soulagement. La fréquence de réoperation et réhospitalisation de ces malades avec carcinome indiquent que les opérations initiales palliatives sont souvent inadéquates. La limitation anatomique et les déterminations cliniques de la résectabilité sont brièvement décrites. Les procédés chirurgicaux palliatifs sont énumérés. L'obstruction duodènale assez fréquente c'est une complication malheureuse et aussi une indication pour réoperation.

RIASSUNTO

Il crescente interesse riguardo piu' ampie resezioni per carcinomi del pancreas e del digiuno e' menomato dalla constatazione che la maggioranza dei pazienti affetti da cancri pancreatico-duodenali sono candidati solo ad un trattamento palliativo. La frequenza di riospedalizzazione e di rioperazione dimostrano d'altra parte che anche l'intervento iniziale, eseguito a solo scopo palliativo, non corrisponde poi all'aspettativa. L'A. discute percio' le limitazioni a carattere anatomico e le condizioni cliniche che influiscono sopra la possibilita' di una resezione di questi tumori: indica inoltre la migliore procedura chirurgica per alleviare almeno le condizioni dei pazienti. Richiama infine l'attenzione sopra la relativa frequenza di un'ostruzione duodenale quale complicazione grave e ribelle, mentre sottolinea le indicazioni per una seconda operazione.

SUMARIO

No obstante el gran interes que hay hoy en dia de practicar resecciones extensivas del pancreas y del duodeno en el tratamiento del cancer se debe de recordarse que la mayoria de los casos de cancer pancreatico-duodenal son candidatos a un tratamiento que es solamente paliativo. La insidencia de la reoperacion y rehospitalizacion de pacientes con canceres inoperables es un indicio que las operaciones paliativas previas fueron frecuentemente insuficientes. Las limitaciones anatomicas y la determinacion clinica de la resectabilidad del cancer de esta region han sido descritas en este papel. Se llama la atencion a la frecuencia relativa de la obstruccion duodenal como complicacion quirurgica y como indicacion para la reoperacion del paciente.

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Vagotomy for Chronic, Nonspecific, Ulcerative Colitis*

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IN 1946, while discussing vagotomy and peptic ulcer with Dr. A. A. Berg of New York, the idea was projected that this procedure might be a feasible therapeutic measure for chronic, nonspecific ulcerative colitis. From this time on a suitable case was sought. At the present writing I wish to present the results obtained in 8 cases of proved chronic, nonspecific ulcerative colitis upon which vagotomies were performed.

It is a well-known fact that in chronic, nonspecific ulcerative colitis conservative treatment has not been gratifying. Routine surgical management necessitates either radical colectomy or ileostomy; these procedures are beset with disastrous complications at times. Furthermore, if any procedure can improve the condition and prevent the necessity of going through life with an ileostomy, such a procedure is justified.

In 1941, Lium[1] reported his results in the removal of prevertebral ganglia in dogs. These animals developed diarrhea and lesions suggesting clinical colitis in man. The results of postganglionic sympathectomy, therefore, might give us a clue to the rationale of vagotomy in this disease.

Dennis and Eddy,[2] in 1947, reported on the evaluation of vagotomy in chronic, nonspecific ulcerative colitis. They concluded that their preliminary investigations indicate that vagotomy offers some promise in these cases. In a recent personal communication[3] with one of these authors (F.D.E.), he stated that in his opinion the greater majority of these cases have shown improvement.

To date I have performed bilateral subdiaphragmatic vagotomy on 8 proved cases of chronic, nonspecific ulcerative colitis. Our first case is reported in some detail.

Case 1. Mrs. F. W., a white female, 56 years of age, entered the hospital with a typical history of chronic, nonspecific ulcerative colitis of seven years duration. She stated that her colitis began when her two sons entered the armed service. The condition became increasingly severe until 1943, when it reached its peak. It had continued as a fulminating condition for the past four and one-half years.

Repeated stool examinations revealed mucus and blood. All examinations for bacilli and amebae were negative. The x-ray examination was typical of ulcerative colitis, revealing a rigid pipe stem colon. Bowel movements occurred so frequently during the day that she practically had to "live on a bed pan." This frequency of defecation continued throughout the night, the stools benig very loose and watery.

Physical examination was essentially normal, with the exception of a far advanced crippling and deforming arthritis.

On November 17, 1947, a transabdominal bilateral vagus nerve section was performed. Within a few days following surgery the number of stools decreased and the blood began to disappear, and at present no trace of blood can be found. The consistency of the stool had changed from a liquid watery stool to a semisolid or well-formed one. She is now able to sleep through the night without being disturbed by a continuous tenesmus and desire to defecate. She has gained weight, feels much stronger and her entire personality has changed for the better. At the present writing, which is approximately a year following surgery, her continued improvement is most encouraging.

Case 5. The most dramatic result was achieved in this case. This was a 32-year-old, white female, with a history of a chronic, nonspecific ulcerative colitis of three years duration. Her treatment consisted of excellent medical care including a two-year regime on chemotherapeutic measures. The patient continued to lose ground and finally an ileostomy was performed. Her condition improved slightly following this, but she was still too ill to leave the clinic at which she was operated upon. She was flown to Chicago in an almost moribund condition with a recurrence of all of her earlier symptoms. The x-ray report which was sent by her previous surgeon stated that not only was her entire colon involved but also the entire small bowel from the ligament of Treitz to the ileocecal valve. Bilateral vagotomy was performed on this patient in July, 1948. At present she is up and

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about, enjoying a highly nutritious diet and is gaining weight.

Case 4. A not so gratifying result occurred in this case. This patient is a 28-year-old white female, who presented the following history: In 1941 she developed a diarrhea associated with mucus and blood in the stool. After careful examination by competent gastroenterologists, a diagnosis of chronic, nonspecific ulcerative colitis was made. Many forms of conservative therapy were attempted, but none of these helped and her condition became progressively and rapidly worse. Ileostomy was advised and performed in 1944 (3 years after the onset of symptoms). There was only temporary and mild relief. Despite the well-functioning ileostomy, she retained a normal desire to defecate, and with each defecation stated that only mucus and blood continued to pass, sometimes more and sometimes less. Physical examination revealed an extremely thin and emaciated female who entered the hospital with unbearable rectal pain. It was impossible to make a rectal examination because of the severe anal spasm. Opiates were required for relief. Following vagotomy the relief of rectal pain was immediate and striking. Rectal examination could now be accomplished without anesthesia. The constant desire to defecate was gone, and the number of stools was reduced from 20 to 30 liquid stools a day to two or three solid stools. The patient was greatly improved mentally as well as physically. The mucus and blood disappeared within a week after surgery. Her improvement was dramatic for a period of three months, and then following an emotional storm which resulted from a divorce court proceeding, her symptoms recurred. Her insulin tests were inconclusive as to the completeness of the vagotomy. In the hope of doing a more complete vagus nerve section, this patient is at present being prepared for a transthoracic vagotomy.

The remaining five cases are typical examples of mild to far advanced chronic, nonspecific ulcerative colitis, all presenting mucus, pus, blood and diarrhea. All of these have responded most favorably to vagotomy.

Observations upon these cases included the presence of blood, pus and mucus in the stools, proctoscopic and barium enema studies, insulin gastric analyses, and electrocardiographic findings. Some studies at present are being conducted on transit time of material through the intestines.

ANATOMY

Unfortunately, there are marked contradictions in the leading textbooks on anatomy regarding the vagi. This is probably due to the fact that erroneous information was obtained from works by Hirschfeld and Leveillé [4] and Kollmann [5] in the middle of the nineteenth century, and many of the modern textbooks have obtained their information from these sources.

Probably the most reliable information comes from E. Perman [6] who, in 1935, performed a series of painstaking and accurate dissections dealing with this subject. His conclusions are interesting, instructive and apparently accurate. He concluded that both vagi reach the stomach through the lesser omentum and that they divide into branches without the formation of a plexus of intertwining fibers. He stated that anastomoses exist between the various branches but that they do not lose their individuality as would be the case in a nerve plexus. The left vagus nerve sends branches to the liver and to the anterior wall of the stomach. Those traveling to the liver turn to the right, pass through the lesser omentum and to the porta hepatis. The gastric branches divide into several smaller nerves, which spread over the anterior wall and can be followed to the greater curvature. The right vagus nerve is arranged in a similar manner; one part to the celiac plexus, and the remainder supply the posterior wall of the stomach. Perman was unable to follow branches of either the left or right vagus into the greater omentum.

Recently papers have appeared dealing with the subject of the nerve supply to the stomach, but they too are quite contradictory. Bradley, Small, Wilson and Walters [7] examined 111 cadavers and concluded that there was a great variation in nerve pattern from the cardiopulmonary plexus to the stomach but that the nerves were very constant in course and distribution after reaching the stomach. They divided the nerve patterns into four groups. Miller and Davis [8] studied the vagus nerves below the level of the pulmonary plexus in 13 cadavers. They stated that in only 3 instances were the nerve arrangements comparable to those described

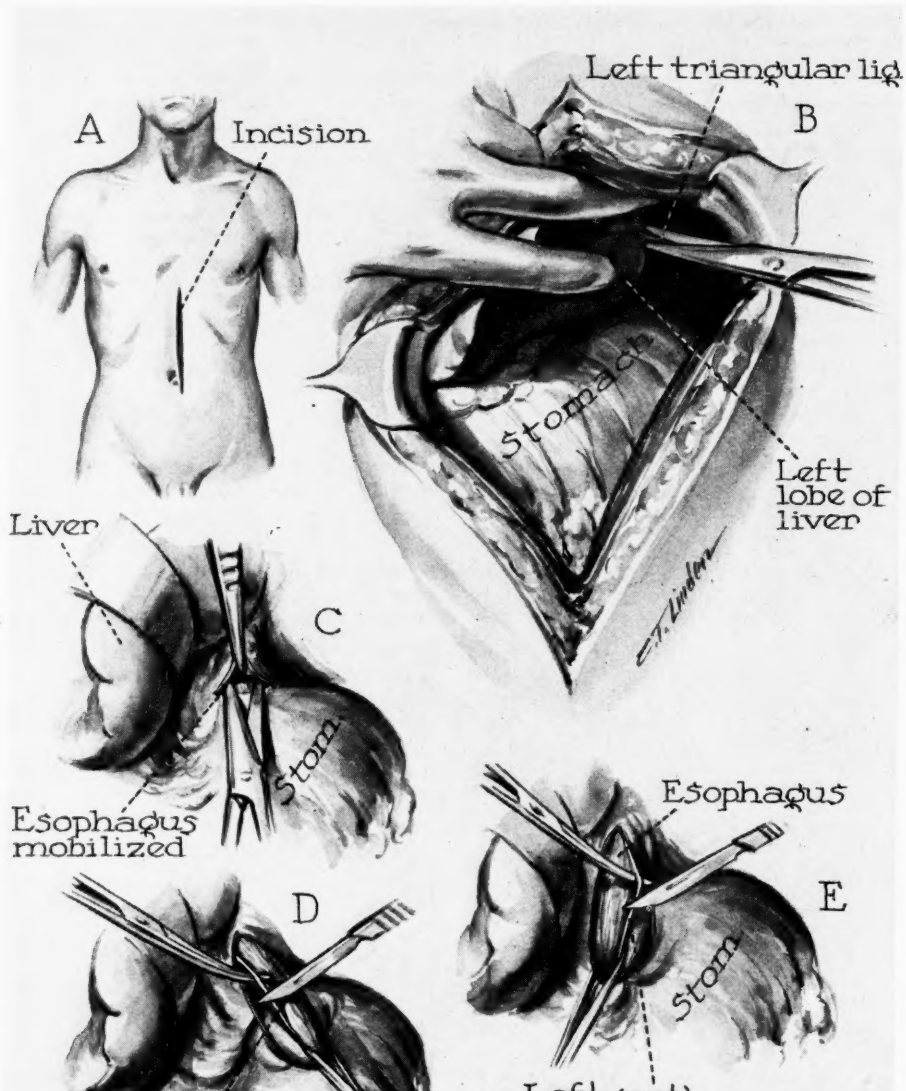

Fig. 1. Transabdominal bilateral vagus nerve section. A. Long left upper rectus incision. B. Left triangular ligament is incised, permitting retraction of the left lobe of the liver to the right. C. Posterior parietal peritoneum is incised over the esophagus, thus making mobilization of the esophagus possible. D. Right (posterior) vagus nerve is identified and severed. E. Left (anterior) vagus nerve is identified and severed.

in the textbooks as "normal," and that the remaining 10 showed marked variations. With this present state of confusion regarding the anatomy one can only conclude that the various vagal patterns must be understood by the surgeon, and complete dissection employed in order that all fibers may be severed.[9]

SURGICAL TECHNIC

Although some might argue that it is inadvisable to traumatize an already inflamed intestinal tract, I feel that the lesions should be seen in an attempt to eliminate possible associated malignant tendencies. Furthermore, since these patients are so critically ill they seem to withstand a transabdominal procedure better than a transthoracic one. At times transthoracic vagotomy may become necessary as was stated above in Case 4.

Transabdominal vagotomy is performed through a long left rectus incision which commences in the angle between the xiphoid and the left costal arch and extends 1 or 2 inches below the umbilicus (Fig. 1). The peritoneal cavity is entered and the left triangular ligament of the liver is exposed and made taut. This bloodless fold is incised, and it then becomes possible to retract the left lobe of the liver to the right. The peritoneum covering the lower end of the esophagus is incised and a finger or scissors is placed into the posterior mediastinum to mobilize the esophagus so that its lower 3 or 4 inches can be delivered into the abdomen. The nerves are identified, ligated and severed, and at times it is possible to isolate and ligate both vagi on the left side. I have observed that the left (anterior) vagus has a tendency to hug the esophagus and that the right (posterior) travels a slight distance away from it; therefore, it is easier to feel and identify the latter. At the conclusion of the operation, the left lobe of the liver is permitted to fall into place; it has been found unnecessary to resuture the severed left triangular ligament.

Postvagotomy atony is believed to be due to a transient increased pyloric tonus; swallowed air and saliva may aggravate the condition so that an acute gastric dilatation results. To prevent this, constant Wangensteen suction is instituted for three to five days postoperatively. This is continued until all tendency toward nausea or vomiting is relieved. Certain medicaments, especially those of the choline group, show some promise in the treatment of gastric atony; time will prove their efficiency. Foul smelling belching and emesis may result; I have not noticed these complaints.

SUMMARY

Eight cases of chronic, nonspecific ulcerative colitis are reported in which bilateral subdiaphragmatic vagotomy has been performed. This procedure shows some promise as a therapeutic measure but no definite conclusions can be drawn at this time. Since the cases previously operated have not suffered any ill effects, and since most of them have actually improved, I feel that the procedure warrants further investigation.

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Solitary Nonparasitic Cyst of the Liver*

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SOLITARY nonparasitic cyst of the liver is a rather rare condition. In 1944 Eliason and Smith [10] reported that at the Philadelphia General Hospital only 28 cases of solitary nonparasitic cysts of the liver were found in 20,000 consecutive autopsies. Davis,[9] in 1937, reviewed the literature and found 499 cases of liver cysts, of which 187 were solitary unilocular cysts and 20 were solitary multilocular cysts. In a 24-year period at Montreal General Hospital [1] there were 10 cases of solitary nonparasitic cysts of the liver in 6141 consecutive autopsies. Cystic changes in the liver have been discovered for the most part at autopsy. Moschcowitz,[19] in 1906, in a review of 85 cases, found 10 cases in which the liver alone was involved, the remainder being associated with cystic disease of the kidney, pancreas, etc.[28]

The relationship of solitary and multiple cysts of the liver is not well understood, and it is thought by many observers that solitary cysts are often the end result of many small cysts coalescing into one solitary cyst of the liver. There is no unanimity of opinion [7, 15, 21] as to the origin of liver cysts. Moschcowitz, after an extensive study, suggested that many originated in aberrant bile ducts, which he was able to demonstrate both in the acini and Glisson's capsule. He believed these aberrant ducts to be embryonic "rests" formed in the development of the liver and the cysts which resulted to be of the retention type.

Davis, Sonntag,[24] Moolten,[18] and Jones [12] have attempted to classify cysts of the liver. According to the following classification used by Ackman and Rhea [1] the condition in most instances is considered to be congenital in origin (see accompanying Table).

This view is strengthened by the fact that nonparasitic cystic conditions of the liver are frequently associated with cystic changes of the kidneys, ovaries, and pancreas. Also, other unrelated anomalies [23] such as polydactylism or meningocele often accompany this condition.

Congenital	*Acquired*
1. Teratoma	1. Degenerated cysts
2. Lymphatic cysts	2. Cystadenomata
3. Blood vessel cysts	3. Bile duct cysts associated with acquired cirrhosis of the liver
4. Ciliated epithelial cysts	
5. Cystic degeneration of liver and kidney	
6. Bile duct retention cysts	

INCIDENCE

Age. All ages are represented in reported cases of solitary nonparasitic cysts of the liver. Witzel [32] in 1880 reported a case in which a large cyst complicated the delivery of a newborn infant. Moschcowitz, in a study of 85 cases, found liver cysts twice in a fetus, 7 times in the newborn, and 4 times in the first year of life. Moolten,[18] Munroe,[20] Stoesser and Wangensteen [25] have reported such cases in very young children. Montgomery [17] states that in 100 cases which he reviewed, this condition was present 25 times in children [29] under 13 years of age. Bland-Sutton [4] reported a case of a large cyst in a woman 75 years of age. The most common age at which this condition is found, however, is in the third and fourth decades of life. Multiple cysts are said to be more common in children.

Race. McCaughan and Rassieur,[14] in their study, found nonparasitic cysts of the liver to be reported in 70 white patients compared to 3 colored patients.

Sex. Females have outnumbered males in the order of 3 or 4 to 1 in reported cases.[22, 27]

SIZE

McCaughan and Rassieur, in an analysis of 80 cases of nonparasitic cysts of the liver, found the fluid content to vary from 110 cc. to an enormous cyst containing 10,000 cc. of fluid. Ochsner [22] reported a case in which a cyst contained 4 gallons of fluid. Others [3, 13] have reported extremely large livers which

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contained multiple cysts weighing up to 26 pounds.

The walls of the cysts vary with the size of the cyst [8] and the length of time which the cysts have been present. In hydatid cysts there is a laminated outer capsule and an inner membrane which carries the daughter cysts. The cysts are under considerable tension. These cysts [26] are to be differentiated from nonparasitic cysts in that there is less tension and the walls are thinner. In the solitary nonparasitic type [8, 11] the wall of the cyst is composed of three layers; an inner layer, rich in cellular elements, ranging from low cuboidal to high columnar cells; the middle layer composed of circular fibers, poor in cell nuclei, and containing few blood vessels; the outer layer, composed of elastic fibers rich in cells, many blood vessels and bile ducts.

SITE

Solitary nonparasitic cysts may be found on any surface of the liver and well embedded in the liver substance. They also may be pedunculated and give rise to symptoms resulting from torsion. The anterior inferior surface of the liver is the most common location, and the right lobe [10] is involved more often than the left lobe. Eliason and Smith in 39 cases found the right lobe to be involved in 25 cases. McCaughan and Rassieur, in reviewing 80 cases, found the right lobe of the liver to contain the cysts in 52 cases.

These observers in their series found the fluid in the cyst to vary in color as follows: clear in 12, chocolate in 11, green in 16, straw in 15. The fluid may contain albumin, mucin, cholesterol, blood, hematoidin, hemosiderin, tyrocine, and granular debris. Rarely they contain bile.

SYMPTOMS

As was stated previously, most cases of nonparasitic cysts were diagnosed at autopsy. A preoperative diagnosis is seldom made. These cysts give rise to few symptoms [2] until they get large enough to cause pressure on adjacent organs. Pressure on the duodenum may give rise to obstructive symptoms. In most instances the chief complaints are a feeling of weight in the abdomen and the palpation of a mass in the abdomen by the patient. Jaundice is not present unless the extrabiliary ducts are impinged upon by the adjacent cyst. The complications of solitary nonparasitic cysts of the liver are (a) torsion of a pedunculated cyst, (b) hemorrhage into the cyst,[6] (c) inflammation of the cyst, and (d) perforation of the cyst with resulting peritonitis. Pressure on the portal vein and interior vena cava may give rise to ascites and edema of the legs.

DIFFERENTIAL DIAGNOSIS

Hydatid disease, hydrops of the gallbladder, pancreatic cyst, and pancreatic tumors are to be differentiated from solitary nonparasitic cyst of the liver. Roentgenograms [5] of the gastrointestinal tract, gallbladder and diaphragm may be helpful. Urograms showing polycystic disease of the kidney may be suggestive that the mass in the abdomen is an accompanying cystic condition of the liver.

Malignancy. Willis [31] reported the only case which resulted eventually in malignancy. This arose from the epithelial lining and metastasized to the liver, lymph nodes, and lungs.

TREATMENT

Extirpation of the cyst is the procedure of choice. This may be a simple procedure in which a clear line of cleavage is followed between the cyst and the liver substance. At times the liver may be so involved that it may be necessary to resort to a resection of a lobe of the liver [7] to remove the cyst. When it is inadvisable to attempt the removal of the cyst, marsupialization [16] may be carried out with the least danger to the patient.

PROGNOSIS

Unless pressure symptoms are produced, these patients may harbor this type of a cyst for many years. When surgery is attempted, the mortality rate ranges from 12 to 25 per cent. Davis [8] reported that surgery was done 226 times in a series of 499 cases with a mortality rate of 22.12 per cent.

CASE REPORT

Mrs. M. L., a white female housewife, age 57, was first seen at the Interstate Clinic on Jan. 12, 1948. Her family history was noncontributory to her present history.

Her chief complaints were distress and a feeling of fulness in the epigastrium. At times the distress would be present to a greater degree in the left upper quadrant of the abdomen and would be worse following the ingestion of food. She stated that for the past two years she had had attacks of pain in the right upper quadrant which would radiate to her right scapular region. These attacks were often initiated by eating fatty foods. She stated she had increasing difficulty digesting fatty foods, and that belching had been more frequent during the past two years. In the three months period prior to being seen at the clinic the patient had experienced four rather severe attacks which had been accompanied by nausea and vomiting. She had been seen by her family physician, who had made a diagnosis of possible gallbladder disease and advised the patient to have this confirmed by x-ray studies. At no time had she had any change in bowel habits, and her bowel movements had been normal in appearance. She stated that she had had four pregnancies, the last 17 years ago. She stated that she thought she "had been torn during her last delivery." During the past three years she had been conscious of the fact that her "womb had been coming out." This had at times caused her to have attacks of frequency and nocturia, and she stated that she "often dribbled urine after coughing."

On physical examination it was found that the patient was a well developed, well nourished female weighing 168 pounds. She wore glasses, and subsequently it was found by examining her eye grounds that she had a moderate degree of arteriosclerosis. The nose and throat were not abnormal.

On examining her neck, it was found she had an adenoma in the right lobe of her thyroid gland that was soft, movable, and not tender. Her chest was symmetrical, and her breasts and nipples were normal. Her lungs were normal to percussion and auscultation. Examination of her heart showed her pulse rate to be 84 per minute and regular. Blood pressure was systolic 180 mm. Hg, her diastolic 110. By percussion the heart was slightly enlarged to the left side. Her abdomen was slightly obese and contained no scars. On palpating her abdomen, a soft mass was palpated below the xiphoid cartilage extending slightly to the left under the costal margin. This was interpreted as being a low, slightly enlarged liver. There was tenderness over the region of the gallbladder on moderately deep palpation. There were no hernias present. Vaginal examination disclosed a third degree procidentia with an accompanying cystocele and rectocele. Rectal examination was normal. Both lower extremities had a few varicosities but no evidence of edema.

X-ray examination of her gastrointestinal tract was negative, and the stomach emptied normally. Cholecystogram disclosed a nonfunctioning gallbladder with "calcified shadows in the right upper quadrant quite typical of calcified gallstones." Intravenous pyelograms showed a slight hydronephrosis and hydroureter on the right side. This was followed by a retrograde pyelogram which disclosed no stone in the urinary tract, and it was thought the slight obstruction to the right urinary tract was due to the displacement of the bladder by the third degree procidentia.

The chest x-ray showed the lungs to be normal and the heart to be left ventricular in shape and probably slightly enlarged. Electrocardiographic findings showed some myocardial damage.

Urine examination was entirely normal. Blood examination showed her hemoglobin to be 12.8 Gm., red cells 4,440,000, white cells 9,800. The differential count showed neutrophils 53 per cent and lymphocytes 47 per cent. The blood serology was negative.

On Jan. 21, 1948, operation was performed through a right upper rectus incision. The abdomen was explored. The liver seemed to be slightly enlarged on the left side, and on gliding the hand over the liver, it was smooth. The gallbladder was thickened and contained many moderately large and small stones. The common duct was not distended. The remainder of the organs of the peritoneal cavity were normal. A Balfour self-retaining retractor was inserted, and it was not until then that a fairly large cyst was discovered in the left lobe of the liver. The gallbladder was removed in the usual manner, and the liver bed was peritonealized. The cyst was then removed from the left lobe of the liver by sharp dissection (Fig. 1). Very little bleeding was encountered, and the falciform ligament and accompanying fat were used to cover the remaining denuded surface of the liver. The appendix was removed. The abdomen was closed in layers without drainage. Her recovery was uneventful, and she was discharged on the ninth postoperative day.

She returned to the hospital in April, 1948, and my colleague, Dr. G. F. Hartnagel, performed a vaginal hysterectomy with repair of the cystocele and rectocele. Since then she has remained well

Fig. 1. Solitary nonparasitic cyst removed from the left lobe of the liver.

with improvements in the findings in the urinary tract.

Pathologic Report by Dr. John Noble. The specimen consists of a cyst of the liver, measuring 18 cm. by 12 cm. by 14 cm. It has a rather thin wall, and on one side there is evidence of liver tissue adherent to the cyst wall. The fluid contents are colorless and slightly cloudy. Microscopically the cyst wall (Fig. 2) is composed of an inner layer of cells having well stained nuclei. The middle layer contains circular fibers with several blood vessels present. The outer layer is composed of elastic fibers, rich in blood vessels, with some accompanying liver tissue visible.

Pathologic Diagnosis. Solitary nonparasitic cyst of the liver.

SUMMARY AND CONCLUSIONS

1. Solitary nonparasitic cysts of the liver are uncommon, and the preoperative diagnosis is seldom made.
2. All age groups have been reported as having this condition, and females are affected more often than males.
3. Extirpation or marsupialization of the cyst have been the surgical procedures most frequently employed.
4. The recent literature has been reviewed.
5. A case is reported in which a nonparasitic cyst was successfully removed.

Fig. 2. Microscopic view of cyst wall. ×70.

SOMMAIRE

Les kystes solitaires nonparasitiques du foie sont rares et il est rare que le diagnostique soit fait préopérativement. Cette affection se rencontre á tous les âges et plus fréquemment chez la femme que chez l'homme. L'extirpation ou marsupialisation du kyste est le procédé chirurgical le plus fréquemment employé. L'auteur passe en revue la littérature récente du sujet. Il rapporte un cas dans lequel un kyste nonparasitique fut extirpé avec succès.

SUMARIO

Los quistes solitarios del higado que no son the origen parasiticos son relativamente raros y su diagnostico preoperatorio es tambien raro. Ocurren en todas las edades y son mas frecuentes en la mujer. La extirpacion o marsupializacion del quiste es el procedimiento quirurgico mas empleado. Se ha hecho una revista de la literatura mas reciente y un caso ha sido reportado en el cual el quiste fue extirpado con resultados excelentes.

RIASSUNTO

Descrive un caso di cisti non parassitaria del fegato, estirpata con successo. Casi del genere sono poco comuni. Raramente una

diagnosi puo' essere avanzata prima dell' operazione. Cisti solitarie del fegato occorrono in qualsiasi eta': le donne offrono una maggiore incidenza. L'A. passa in rivista la letteratura sopra l'argomento. La procedura chirurgica piu' comune consiste nell' estirpazione o nella marsupializzazione della cisti.

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The Cystic Duct: Its Role in Health, Disease and in the Complications and Sequelae of Gallbladder Surgery*

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THE cystic duct is the channel through which bile passes into and out from the gallbladder. It is the narrowest portion of the extrahepatic biliary system and varies in length, diameter, shape, internal architecture and in its relations to surrounding structures. In 100 normal specimens 20 were found to be less than 2 cm. long, 55 were between 2 cm. and 4 cm. long and 25 were more than 4 cm. long. The circumference varies between 4 mm. and 10 mm. with an average of 6 mm. In form it may be spiral, kinked, constricted, tortuous; some appear to be knotted. The internal surface in many instances is divided into two distinct portions: a proximal portion with projections from its surface—the "valves" of Heister[1]—and a distal portion, which is smooth and free from these projections. The former is known as the "pars convoluta"; the latter, as the "pars glabra." When the cystic duct is fully distended the caliber of the pars glabra is greater than that of the pars convoluta. The "valves" of Heister are folds in the wall of the cystic duct similar to the pleats of an accordion. They represent duplications of the wall projecting into the lumen and effect a convoluted appearance on the external surface.[2] This convoluted appearance of a duct which is smaller in caliber than that of the other extrahepatic ducts is characteristic and serves to identify the cystic duct specifically. Its origin from the gallbladder and confluence with the common hepatic duct to form the common duct (ductus choledochus) also helps to identify it. The junction of the cystic duct with the hepatic duct varies considerably. Many join at an acute angle; some run parallel for a considerable distance; while others may form a spiral anterior or posterior to the common hepatic duct before effecting a continuity of their lumens.[3] At the junction of the cystic duct and the common hepatic duct a leaflike fold is present on the internal aspect. This projects toward the distal portion of the common duct and acts like a wing dam deflecting the flow of bile from the cystic duct. When obstruction in the common duct follows contraction of the sphincter of Oddi, increase in tone of the duodenal musculature, lodgment of a stone or the development of a tumor, bile passes into the cystic duct and enters the gallbladder. Thus, anatomically, the filling of the gallbladder is dependent on an increase in pressure in the common duct due to the closure of the outlet of the latter. When there is no obstruction to the passage of bile from the liver to duodenum the gallbladder does not fill.

In the intact gallbladder there may be an obstacle to the flow of fluids into or out from the gallbladder between the body and the neck and between the neck and the cystic duct. While no definite sphincter has been demonstrated, one must admit the possibility that a sphincter may exist without an organized muscle band that can be demonstrated anatomically.[4] The cardiac sphincter of the stomach is an illustration of such a possibility. In examining the gallbladder, however, one finds that the two locations where sphincters have been suggested are anatomic sites of bends in the continuity of the gallbladder. These bends in some instances represent a change in direction amounting to 180 degrees. Disturbances here have been termed intervesiculocystic dyskinesia.[5] This is an anatomic disturbance, mechanical in origin, in contrast to the spastic disturbances usually described.

The cystic duct is subjected to varying pressures up to 25 cm. of bile pressure from the gallbladder and up to 80 cm. of bile pressure from the common duct. The gallbladder pressure is acquired directly from the contraction of its musculature and possibly to some extent indirectly from the pressure of

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adjacent viscera or is transmitted from the thorax. In the common duct, the pressure is determined by the action of the sphincter of Oddi and the tone of the duodenal musculature. The cystic duct is devoid of any organ-

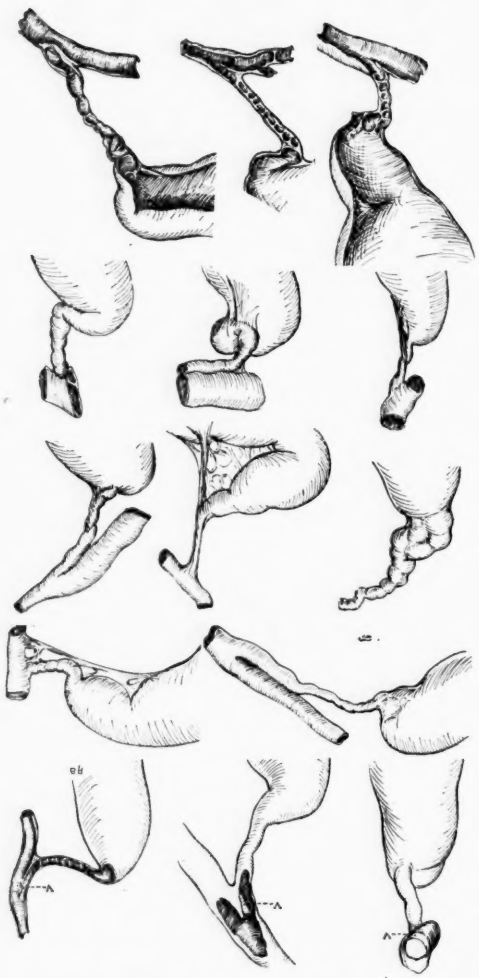

Fig. 1. Variations in the form of the cystic duct.

ized system of musculature, which by itself could by contraction produce changes in the internal pressure in the cystic duct.[6] The presence on the cystic duct of numerous nerve ganglia makes this a sensitive portion of the extrahepatic biliary system. It is possible, therefore, that the purpose of the "valves" of Heister is to retard distention of the cystic duct during the changes in pressure. Also, they may maintain the patency of the lumen. In those instances where the distal portion of the cystic duct is devoid of "valves" (pars glabra), dilatation does occur. This would indicate that the "valves" of Heister constitute an architectural device to maintain the size of the duct in the presence of changing pressures both in the gallbladder and in the common duct.[7] The "valves" of Heister, when normal, constitute an anatomic factor of safety.[8]

PATHOLOGIC CHANGES

The narrowness of the channel which connects the gallbladder to the common duct predisposes it to obstruction.[9] Edema of the entire wall or of the mucosa alone, even though slight, may be sufficient to produce interference with the filling or the emptying of the gallbladder. The duration of this obstruction will, to a certain degree, determine the extent of permanent change, since inflammation with damage to the mucous membrane determines an altered physiology of the gallbladder. Inflammation may develop and subside without producing obstruction in the gallbladder or the hepatic and common ducts; but the narrow channel in the cystic duct is more readily occluded under the same circumstances and hydrops or empyema of the gallbladder may follow.[10]

Anatomic relations[11] of the cystic duct to adjacent organs predispose it to pathologic changes. The venous plexus covering the cystic duct may involve the duct, especially when thrombophlebitis or thrombosis of the veins takes place. The cystic artery, too, may be involved in an inflammatory process and cause a change in the vascularity of this part. The following outline, slightly modified from the important paper by Cole and Rossiter,[12] summarizes the common causes of cystic duct obstruction:

1. Stone or stones in the cystic duct.[13]
2. Stenosis produced by a thickened wall.
3. Stenosis produced by surrounding adhesions.

4. Twists, kinks and valvelike anomalies: (a) developmental, (b) congenital, (c) acquired, (d) inflammatory.
5. Congenital or inflammatory lesions[14] involving "valves" of Heister: (a) fibrous strands, (b) local thickening of the wall, (c) stricture due to scar following ulceration.
6. Tension induced by an enlarged liver, visceroptosis or loss of pericystic fat.
7. Compression or filling defect due to tumor[15] or lymph nodes.
8. Obstruction due to an anomalous hepatic or cystic artery.

It has been pointed out that allergic[16] cholecystitis is an entity, and Necheles[17] reported the finding of an eosinophile mucus plug obstructing a cystic duct.

CLINICAL APPLICATION

Any regimen which would facilitate the passage of bile into and out from the gallbladder would reduce the incidence of symptoms related to the filling and emptying of the gallbladder.

Hepatic bile usually is sufficiently dilute to pass readily into the gallbladder. In this organ bile is concentrated from two to ten times, depending on the content of solids in the hepatic bile. On leaving the gallbladder the concentrated bile, mixed with mucus, is thicker and does not pass through the narrow duct with the same ease that dilute hepatic bile entered this organ. Even in the absence of any degree of obstruction a concentrated bile may have such impaired passage that the tension in the contracting gallbladder produced by a normal response of the gallbladder musculature to an adequate stimulus results in acute pain similar to the distress induced by acute spasm of the duodenal musculature or the sphinter of Oddi. Concentrated bile also favors precipitation of bile pigment and cholesterol. Small stones so formed may lodge in the cuplike "valves" in the cystic duct and produce complete obstruction. Further, a concentrated bile may be more irritating chemically or allergically to a sensitive mucous membrane and result in inflammation with occlusion. Thus, any condition which favors a concentrated bile or any condition which favors prolonged storage of bile will predispose to gallbladder disease.

Common causes for a concentrated bile are hypohydration due to inadequate intake of fluids or excessive loss of fluids. A history of typhoid fever, pneumonia or other febrile disease of extended duration during the years when intravenous fluids and specific therapy were not as available as they are today is frequently noted in patients with gallbladder disease. It is likely that in these conditions concentration of bile may have predisposed to gallstone formation and gallbladder disease. Adequate hydration in any febrile disease as well as under normal circumstances is of importance in maintaining a dilute bile and preventing the ill effects of a concentrated bile.

Associated with this, the frequent emptying of the gallbladder of its dilute bile will "flush" the cystic duct and prevent stagnation of bile in the gall bladder. Since fat is the normal stimulus for gallbladder contraction,[18] it must be included in the diet at least once and preferably more often each day. The obese patient who "diets" to reduce by eliminating fat may allow precipitation of pigments and cholesterol in the stagnant bile of the nonemptying gallbladder. In pregnancy, too, stagnation occurs, and stimulation of this organ with fat in the diet may be a specific necessity. The anatomic possibility of pancreatic juice entering the gallbladder[19] and inducing chemical changes which favor precipitation also warrants frequent emptying of the gallbladder. A freely flowing dilute bile may avoid some of the causes for the development of acute duct obstruction with gallbladder disease.

SURGICAL ACCIDENTS

The cystic duct may be fixed to the hepatic duct or lie adjacent to the hepatic artery so that ligations of either of these important structures may be done by accident. A short cystic duct may be completely overlooked and the common duct may be ligated or clamped. In addition, clamping of the cystic duct may kink the hepatic or common duct with resulting postoperative jaundice. Insecure ligation of the cystic duct may result in an extensive

accumulation of bile in the subhepatic and also in the subdiaphragmatic space. Stricture of the hepatic or common duct [20] following cholecystectomy either immediately or more remotely after operation frequently requires a formidable operation for relief of jaundice caused by the mechanical obstruction. Despite the ingenious and highly technical operations which have been devised to relieve the patient, the development of liver damage often determines a fatal outcome. Thus, in gallbladder surgery satisfactory exposure of the cystic duct is essential to avoid the complications so frequently discussed in the surgical literature.

SEQUELAE TO CHOLECYSTECTOMY

The causes for persistence of symptoms following cholecystectomy fall into three groups: (1) Failure to remove the cause of symptoms other than the diseased gallbladder. (2) Spastic disturbances in adjacent organs giving rise to symptoms like those in gallbladder disease. (3) Failure to remove the gallbladder completely, especially the neck and the cystic duct.

Failure to Remove the Cause of Symptoms, Other than the Gallbladder. It has been estimated that 20 per cent of the adult population have stones in the gallbladder.[21] The finding of stones in a patient with symptoms referable to the upper abdomen does not necessarily indicate that they are the cause of the symptoms. Other diseases may be present such as an inflamed appendix, chronic bowel distress, esophageal hiatus hernia, visceral carcinoma, allergy, cholangitis, hepatitis, peptic ulcer, pancreatitis, mesenteric adenitis, diverticulitis, and extraabdominal conditions such as intercostal neuritis, thoracic arthritis, myositis, pleuritis, etc. The removal of a gallbladder with stones when the symptoms did not originate from gallbladder disease is not likely to be followed by relief of symptoms. This error may be avoided by a more accurate diagnosis. Also, when cholecystectomy is undertaken, an adequate abdominal exploration should be done prior to the removal of the gallbladder to determine the presence of other pathologic conditions that may be responsible for the patient's symptoms.

Spastic disturbances involving the sphincter of Oddi, duodenum, pylorus, antrum and colon frequently simulate the dyskinesia,[22] dystonia [23] or dyssynergia [24] of the noncalculous gallbladder. The removal of the gallbladder does not remove the fundamental cause of the symptoms related to the nervous system and it is likely the symptoms will persist following cholecystectomy.

Failure to remove the gallbladder, more especially its distal portion, results frequently in persistence of symptoms.[25] Many case reports have been published indicating that relief from persistent symptoms following cholecystectomy has followed reoperation with removal of the stump of the cystic duct.

The distal end of the cystic duct (pars glabra) tends to dilate sometimes to the size of a small gallbladder.[26] This is not a regeneration of the gallbladder. The absence of musculature here favors stagnation of bile with stone formation. A stone situated here may obstruct the hepatic or the common duct and produce jaundice. The extensive network of nerve ganglia about the cystic duct may account for the persistence of symptoms following distention of this stump.

SUMMARY

The cystic duct though small is situated anatomically at a site where it may determine extensive and even fatal disease of the liver. Accidents due to surgery involving the ducts are exceedingly disabling and may be fatal, as from acute hemorrhage or chronic liver disease following stricture of the common duct. A remnant may determine a chronic state of "gallbladder disease" in the absence of the gallbladder. It is suggested that a freely flowing thin bile may avoid stone formation and the serious effects of obstruction of the cystic duct.

SOMMAIRE

Le conduit cystique, quoique petit est situé anatomiquement où il peut déterminer des lésions étendues et parfois fatales du foie. Les accidents dus à la chirurgie intéressant les conduits biliaires sont sérieux. Il peuvent être fatals. Une hémorragie aiguë où une maladie chronique du foie, consécutive à un

retrécissement du cholédoque sont des accidents postopératoires. Un débris de la vesicule biliaire peut déterminer un état chronique qu'on désigne parfois maladie de la vésicule biliaire. L'auteur suggère que l'écoulement facile et abondant d'une bile très fluide peut empêcher la formation de calculs biliaires et les conséquences sérieuses résultant de l'obstruction du conduit kystique.

RIASSUNTO

Per quanto sottile, il dotto cistico ha una sede anatomica per la quale puo' determinare estese e talvolta fatali lesioni del fegato. Incidenti dovuti ad interventi operativi interessanti i dotti cistici possono essere immediati, quali emorragie acute, o terminare in un' affezione cronica del fegato qualora si determini una restrizione del coledoco. La persistenza di un piccolo tratto del dotto cistico puo' condurre ad una sindrome che ricopia quella della cistifellea, anche se asportata. Un libero deflusso della bile, non ispessita da ristagno, e' da considerarsi la condizione migliore per evitare la formazione di calcoli e le conseguenze, relativamente serie, di un' ostruzione del dotto cistico.

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Considerations in the Preoperative and Postoperative Management of Patients Requiring Gastrostomy*

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GASTROSTOMY is an operation in which pre- and postoperative management may, to a large extent, determine the success of the operation regardless of the type of procedure employed. Of all gastric operations, gastrostomy is among those not well understood and often neglected. Since gastrostomy at best is a palliative procedure a subconscious sense of hopelessness may cause the surgeon to take half-hearted measures in the preparation and after-care of these patients.

The primary purpose of this paper is to direct attention to a detailed and workable preoperative and postoperative plan for patients in whom gastrostomy is indicated. The second is to call attention to and stress the direct relationship that exists between preoperative and postoperative management and the successful outcome of a gastrostomy operation.

When a patient with carcinoma of the esophagus is told for the first time that he must have a gastrostomy, he is horrified by the thought of having to go through life artificially nourishing himself by tubal feedings. Almost invariably he will refuse the operation and express his preference to return home with some alternative plan of his own for feeding himself. After several weeks of unsuccessful efforts at doing so, the patient returns, psychologically prepared to accept any relief which will stave off impending death by starvation.

At this time the surgeon is confronted by a patient who is extremely weakened, dehydrated and emaciated. Further study reveals that these patients suffer from a severe protein deficiency that makes them unfit to withstand a major surgical procedure. The body, in an effort to sustain life during starvation, breaks down its own stores of fat, glycogen, and tissue protein. When such a catabolic process sets in and continues unabated, death is inevitable.

Heroic efforts in the form of immediate surgical intervention during this rapid breakdown phase, in an effort to feed the patient directly into the stomach, will accomplish little in the way of preventing death by starvation. Yet, not infrequently, one sees a patient with carcinoma of the esophagus brought in for an "emergency gastrostomy." The rationale of such a procedure is questionable at any time. What benefit can a markedly emaciated and dehydrated patient possibly receive from direct tubal feedings that cannot be surpassed a hundred-fold by the systematic intravenous administration of measured quantities of blood, plasma, dextrose in distilled water, normal physiologic salt solution, concentrated vitamins, and amino acids? I would like to reiterate that in the case of an obstructing carcinoma of the esophagus no emergency or urgency exists for performing a gastrostomy so long as there are available adequate facilities for carrying out a proper preoperative program.

A patient with carcinoma of the esophagus is considered ready for gastrostomy when dehydration is overcome, sugar stores replenished, vitamin deficiencies improved and, if possible, total proteins restored. The condition of a person in need of a gastrostomy can only be made worse by surgery when the preoperative management is not carried out properly. Likewise, the postoperative plan is routinely carried out. An acceptable plan for pre- and postoperative management of gastrostomy patients is dedicated to the principle that existing abnormalities and deficiencies must be improved before the patient is subjected to surgery. Such a plan is suggested below.

Food by mouth is withheld from the patient, not even water being allowed by mouth. Parenteral nourishment can be utilized so satisfactorily, that it leaves little to be desired.

* From the services of Dr. Raymond W. McNealy at Cook County Hospital and Wesley Memorial Hospital, Chicago, Illinois.

PREOPERATIVE PROCEDURE [1]

A. Workup:

1. Urinalysis.
2. Complete blood count.
3. Wassermann or Kahn.
4. Total protein determinations.
5. A-G ratio.
6. Attempts to aspirate stomach contents are not recommended because of the hazard of perforating the wall of the esophagus.
7. Type and cross-match blood. (Have two donors available before, during, and after surgery.)

B. Medication:

1. Antiseptic mouth washes.
2. Night medication (hypodermic).
3. Cevitamic Acid (1000 mg. daily).
4. 1 ampule of vitamin B complex (Solu-B, 1 ampule) intravenously.
5. Transfusions repeated if necessary.
6. Parenteral fluids.
   a. 2000 cc. of 5% dextrose in distilled water.
   b. 1000 cc. physiologic saline.
7. Parenamine (or any good proprietary brand of amino acids), 60 to 150 Gm. daily.
8. Morphine sulfate, gr. 1/6 } 1 hour before surgery
   Scopolamine, gr. 1/150 }

C. Management:

1. SS enema (night before surgery).
2. Nothing by mouth.
3. Abdominoperineal prep. (breast to mid-thighs).
4. On call to Surgery (15 min. before surgery).

POSTOPERATIVE PROCEDURE

A. Medication:

1. Continue with the above preoperative orders until tubal feedings can be safely instituted.
2. Morphine sulfate, gr. 1/6, P.R.N. for pain and restlessness.

B. Management:

1. The patient is fed by tube after a stoma is established.
2. Formula for a 24-hour period:
   a. *Recipe:*
      1000 cc. homogenized milk
      500 cc. cream
      300 cc. orange juice
      4 eggs
      5 Gm. sucrose (5 tablespoonfuls)
      5 Gm. salt (1 teaspoonful)
      5 Gm. yeast (1 cake)
      2 oz. liver extract
      Cod or haliver oil, 20 min.
      Amino acids (Parenamine, protein hydrolysate, or Amigen), 60 to 150 Gm.
   b. *Preparation:*
      Mix milk, cream and solids; add well-beaten eggs. Gradually add orange juice; add vitamins last.

The completed formula is kept in the refrigerator, but the feedings are given at room temperature in amounts varying from 4 to 12 ounces or more, depending upon the patient's tolerance. Do not forcibly inject the feedings, but rather allow the feeding to flow into the stomach by gravity. The patient should be instructed to pinch the catheter before removing it from the stoma as a precaution against spillage upon the abdominal wall. At first, I prefer to use a 14 F. catheter when feeding the patient, but the size is gradually increased to an 18 F. and even a 24 F. catheter. The skin about the gastrostomy stoma is protected with aluminum paint or paste. This prevents the skin from being irritated and possibly digested by gastric juice, which is constantly being secreted by the lining of the gastric tube. A small cotton-ball placed directly over the stoma and covered with a piece of gauze will absorb whatever gastric juice may form from the tubal lining in the period between feedings.

Unfortunately, patients with a gastrostomy are discharged from the hospital with no other instructions than how to prepare their diets and manage their feedings. Occasional visits to the doctor's office may be recommended.

[1] McNealy, Raymond W.: Pre- and Postoperative Management, in preparation.

In my opinion, the life of a gastrostomy patient might be appreciably prolonged and rendered more livable were the surgeon to keep in mind that a patient feeding himself artificially may stave off starvation but by no means stop the progress of the carcinomatous growth. The carcinoma continues to grow, invade, and metastasize despite the palliative surgical procedure. The growth of the carcinoma necessitates a greater utilization of nitrogenous material which it derives from the ingested food and the breakdown of tissue protein. This catabolic state leads to severe malnutrition, weakness, anemia, and susceptibility to infection. So long as the latter complication does not intervene, I believe the patient's downward course can be periodically interrupted with a booster regimen as outlined under preoperative management above. That would necessitate having the patient enter the hospital at three- or four-week intervals to receive a blood transfusion and supplemental amounts of sugar, water, salt, vitamins, minerals, and proteins.

In my experience, the above procedure has effectively prolonged the life of gastrostomy patients from 10 to 30 per cent beyond previous survival limits.

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Dupuytren's Contracture of the Foot*

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DUPUYTREN,[5, 6] in 1832, in 2 instances mentioned the lesions of the feet involving plantar fascia simulating the contracture which bears his name and which involves the palmar fascia in the hands. That there is a contracture of the foot, either associated or not associated with the same type of lesion in the hand, has been recognized since that time. Although the writings on Dupuytren's contracture of the hand are voluminous, there are few descriptions of a similar lesion in the plantar region. In more recent literature Kanavel, Koch and Mason,[10] in 1929, reported 2 cases of plantar lesions. In 1934, Powers mentioned 9 cases.[16] In 1936, one of us (H.W.M.)[13] found, in a study of 273 contractures of the hands, that 4 patients had a similar bilateral involvement of the feet. In 1939, Greenberg[7] discussed the subject of the association of palmar and plantar Dupuytren's contracture and mentioned 1 case in which the patient had involvement of both hands and the right foot.

Sir Astley Cooper[2] is credited by Hancock with recognition of the pathologic changes of Dupuytren's contracture and with describing the condition in the literature prior to the reports of Dupuytren.

In 1948 one of us (H.W.M.) discussed Luck's report[11] of 14 cases in which all patients had bilateral involvement of the hands and an associated plantar lesion; of these 14 patients, 2 had involvement of only one foot and 12 had involvement of both feet. Nine of these 14 patients underwent surgical excision.

MATERIALS AND METHODS

In our study we have reviewed all cases of Dupuytren's contracture in which the patient was seen at the Mayo Clinic from 1928 through 1947; in 24 (2.7 per cent) of these 882 cases there was involvement of the feet or a foot. In these cases we studied the hereditary factors, history of trauma, location of the lesion, association with lesions of the hand and the occupation of the patient, and in those cases in which the patient underwent operation we reviewed the microscopic findings. We have also made an attempt to evaluate the results of surgical treatment and the value of roentgen therapy.

The average physician, unfamiliar with the lesion of the plantar fascia, seldom looks for involvement of the feet in his examination of the patient who has Dupuytren's contracture involving the hands. Because of this fact, the cases available for study are not as numerous as they might be. Patients who have Dupuytren's contracture of the feet may be fitted with arch supports or special shoes, without relief of symptoms. In every case in which the patient has Dupuytren's contracture of the palmar fascia, the soles of the feet should be examined to determine whether or not there is involvement of the plantar fascia. The case illustrated in Figure 1 has been reported in full by Jackson and one of us (H.W.M.).[14]

The lesion may be more readily discovered by dorsiflexion of the foot and toes, which tautens the plantar fascia and the flexor tendons, with the result that the contracture becomes more evident. In Dupuytren's contracture of the foot one might expect to find plantar flexion of the toes, analogous to the flexion of the fingers seen in similar lesions of the hands, but we have not observed any severe degree of flexion in our cases.

The actual discovery of the lesion in the foot was often made after recognition of Dupuytren's contracture of one or both hands. In one of our cases, the patient underwent operation for Dupuytren's contracture of the left foot, and bilateral involvement of both hands and the right foot later developed. In 12 (50 per cent) of the 24 cases in this series plantar nodules or contractures were associated with lesions of the hands. In the

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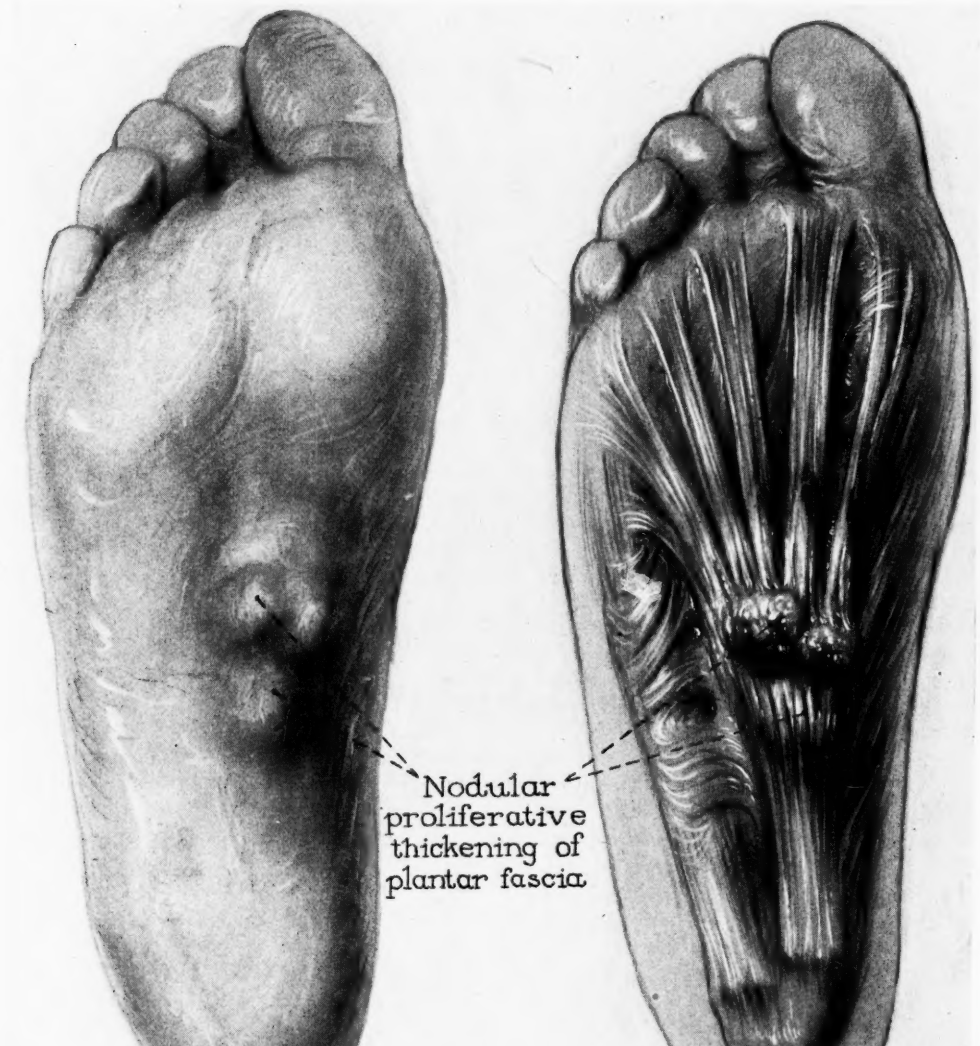

Fig. 1. a, Nodular tumorlike masses in the plantar fascia of the arch of the foot; b, plantar fascia exposed and type of involvement found at time of operation.

other 12 cases of lesions of the plantar fascia there was no involvement of the hands. Six of the patients of this latter group came to the clinic because of nodules or "tumors" of the feet; 2 came because of pain and aching, and 4 sought further surgical advice

Fig. 2. Resting stage. Closely packed fibrous tissue with little cellular activity and small nuclei. ×85.

Fig. 3. Late active stage. Perivascular round-cell infiltration with increased nuclear markings. ×95.

after excision elsewhere of a tumor of the arch of the foot, on which a diagnosis of malignancy had been based. In 1 of the foregoing cases, the patient had undergone operation, a diagnosis of fibrosarcoma had been made and amputation had been advised.

The lesion usually is in the form of one or more palpable nodules involving the arch of the foot. It was found that the tumor-like nodules were composed of fibrous tissue and involved the plantar fascia along the longitudinal arch, and that there was a tendency for linear extension. The skin over the arch of the foot often may be dimpled, fissured or fixed as a result of fibrosis.

Of the total number of cases of contracture of the plantar fascia, the right foot was involved in 6 cases, the left in 6 cases and there was bilateral involvement in 12 cases. A history of trauma, such as cuts, abrasions, nails in the shoes and so forth, was obtained in 7 (29 per cent) of the cases. Of the 24 patients seen, 8 were housewives, 2 were physicians, 2 were lawyers, 2 were students, 4 were waiters, and 1 each was a carpenter, a common laborer, an executive, a plasterer and a salesman; 1 had no occupation. Hereditary factors were evaluated to the best of the patient's knowledge in each case. Inquiry revealed 2 cases in which there was a history of Dupuytren's contracture in the family; one patient's father and the other's mother had had it. The condition was almost evenly divided between the sexes, as there were 13 males and 11 females. The youngest patient was 13 years of age and the oldest 61 years, with a mean age of about 39 years. The duration of symptoms was unknown in 7 of the cases; the mean duration in the remaining 17 cases was about eight years. The shortest duration of symptoms was six months and the longest was 25 years. The result of the flocculation test for syphilis was not significant; of the 24 patients, 23 had a negative reaction and 1 had a positive reaction.

In no case was there associated Peyronie's

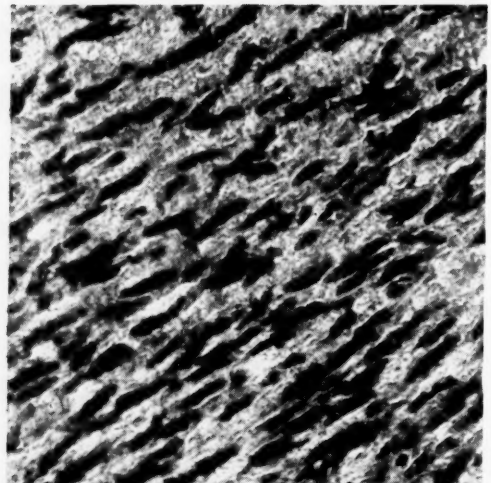

Fig. 4. Active stage. Active cellular proliferation with dark, hyperchromatic-staining nuclei and loose fascial strands. ×400.

disease, in which there is fibrous contracture of the penis; this has been noticed by others in connection with the lesions of the hand.

PATHOLOGIC FINDINGS

The microscopic findings were reviewed in the cases in which operation was performed at the clinic. In addition there was 1 case in which we had examined the tissue sent to us, but this tissue was not available for our review study. In 5 of the cases reviewed the tissue removed was found to consist of fibrous tissue, closely packed, with small light-staining nuclei between the strands. There was very little evidence of perivascular infiltration or of cellular activity. These cases were in the so-called resting stage as shown in Figure 2. Nine cases showed evidence of chronic inflammation, and were good examples of increased nuclear markings, perivascular round-cell infiltration and nodular proliferation of fascia as shown in Figure 3. Cases in which the findings might be mistaken for those of sarcoma were those which showed increased cellular proliferation, dark hyperchromatic nuclei, dark-staining round cells between the loose fascial strands, evidence of increased blood supply and perivascular round-cell proliferation as shown in Figures 3 and 4. These stages or changes seen in the tissue removed at operation were interpreted as being the result of chronic inflammation.

The course and appearance of plantar Dupuytren's contracture, we feel, is best divided into two stages: (1) the active stage, early in the disease, with gross evidence of formation of nodules, tenderness and slight pain, and microscopic evidence of increased fibroblastic activity with cellular proliferation and perivascular round-cell infiltration; (2) the resting stage, late in the disease, with hard, nontender nodules, fascial scarring and contracture, and a microscopic picture of dense fibrous tissue, closely packed nuclei and loss of surrounding areolar substance.

ROENTGENOGRAPHIC FINDINGS

The roentgenographic examination was found to be of negative value in our study of this disease, as the report was negative for bone changes in all cases. These findings would be of value, however, when there was a question of tumor formation and the surgeon wished to know whether or not there was involvement of bone.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of this disease must be made from other conditions of the feet, such as scars from previous trauma, callosities, benign fibroma, chondroma, exostosis and fibrosarcoma. There were 2 cases in our series in which the contracture in the active stage could have been mistaken for a malignant lesion. If the pathologist or the surgeon will bear in mind that the cellular microscopic appearance of Dupuytren's contracture may show active fibroplasia and even mitoses, this error may be avoided.

TREATMENT

The treatment of this disease is complete surgical excision of the involved regions of

plantar fascia. The incision usually is slightly curved mesially at the arch of the foot; the plantar fascia is then exposed, dissected free proximally to the contracture by tunnelling beneath, grasped with an artery forceps and divided, after which it is lifted from its bed by dissection carried distally. Hemostasis should be meticulously carried out. Because the toes are not as extensively involved in the foot as are the fingers of the hand, it is seldom necessary to make an extensive lateral dissection of the fascia about the toes. In our series of 24 cases, operation was performed in 14 cases. Of these 14 cases, there were 2 in which bilateral excision of the plantar fascia was performed, 8 in which excision of the contracture from the right foot was performed and 4 in which excision of the contracture from the left foot was performed.

Roentgen therapy was used as a postoperative adjunct in 3 cases; it was not used as the sole method of treatment in any of our cases. We have not employed penicillin or other new drugs as an adjunct to the treatment of patients who had Dupuytren's contracture of the feet.* Vitamin E or the tocopherols have not been utilized to any extent in the treatment of our patients and at the present time we are unable to comment on their value.

ETIOLOGIC HYPOTHESES

The etiologic hypotheses concerning this disease are many and varied. Dupuytren [5, 6] felt that occupation, when it involved the use of the hands, and continued and sustained trauma, were very important aggravating factors. We are still of the same opinion today.

Hancock [8] expressed the opinion that the disease is not a definite entity, but that it represents a biochemical or metabolic disturbance akin to gout or rheumatism, and that focal infection and trauma may be contributing factors.

In association with Black and Broders, one of us (H.W.M.) [15] in 1941 studied the microscopic sections of Dupuytren's contracture and came to the conclusion that the pathologic picture was best explained on the basis of a chronic inflammatory process, aggravated by repeated trauma.

In 1944, Corlette [3] studied this disease and stated that the most likely alternative was that all cases of Dupuytren's contracture were familial and would always be found so if the descent and complete family history were known. In 1939, Mason [12] also expressed the belief that heredity was the most important etiologic factor.

In 1942, Horwitz [9] felt that the essential process was benign fibroplasia, or fibroblastic diathesis, and that this process bore a striking resemblance to keloid and fascial desmoid. He also felt that heredity and senility were important predisposing factors.

In 1944, Clay [1] expressed the opinion that this disease was explained on the basis of neoplasm of the fascial fibroma group.

Other authors have advanced many other hypotheses as to the cause of this lesion. These hypotheses embrace trauma, heredity, focus of infection, occupation, neurogenic factors and others.

Comment on Etiology. In this condition we feel that the degree of contracture and fibrosis is aggravated by trauma and function, thus causing progression of the lesion, with resultant deformity and increasing disability. It has still to be proved that trauma is the actual exciting agent in Dupuytren's contracture of the foot.

We have found in our own cases that heredity is given as a factor in approximately 8 per cent, although there were instances in which no inquiry as to the heredity was made. We therefore feel that it is doubtless a predisposing factor in the disease.

In our previous studies of Dupuytren's contracture,[13] the presence of foci of infection elsewhere in the body usually was compatible with the patient's age. We feel that infection does not have an important influence, although it may contribute to the condition by liberation of toxins. We feel that the trauma involved in certain occupations also may be an aggravating factor. Although the

* Dr. Douglas Dickson [4] observed 1 case in which the patient had Dupuytren's contracture of the hand accompanied by postoperative swelling, and in which penicillin was administered with beneficial results. We have observed an apparent improvement in a case of Dupuytren's contracture of the hands, in which the patient had not undergone operation and was given penicillin.

condition is found in lawyers, physicians and executives, these patients may have sustained injuries or performed hard labor early in life.

The suggestion that reflex or atrophic changes of the central nervous system may constitute a cause of this disease is interesting, but we do not feel that we have definite proof to substantiate such a conception. It is our impression that the condition is more prevalent among older patients whose circulation is not adequate, with the resultant degenerative changes, and whose hands and feet may have been subjected to trauma with injury of the fascia, and subsequent reparative fibrosis. In some instances the condition is further aggravated by chronic infection.

The periodic episodes of aching pain and tenderness associated with subcutaneous localized nodules of the soles of the feet, as well as microscopic findings, do not appear to us to be compatible with a neurogenic lesion.

During previous studies of this condition in the hand [15] it was observed that chronic inflammatory change usually is found in cases of Dupuytren's contracture. This study of the condition in the foot substantiates this opinion. Grossly, the nodules and cords form in the fibrous tissue of the plantar fascia, and these nodules and cords later become a thickened mass in the mesial side of the arch of the foot. In the early active stage there are foci of fascial and focal necrosis surrounded by low-grade inflammation. New growing nodules will show evidence of round-cell perivascular infiltration, will exhibit immature fibroblasts and nuclei and will often simulate a tumor-like mass. Hence, these new nodules represent the early stage of fibrosis, and it is at this stage that the histopathologic examination of the tissue might be interpreted as showing fibrosarcoma, an interpretation which in fact had been made in 4 of our cases. As the fibroblastic process extends, the subcutaneous areolar tissue is replaced and destroyed in varying degrees. As the contracture becomes thicker and more nodular, the adjacent skin becomes fixed to the mass. In the advanced stage of the disease, there will be seen only mature fibrous tissue with almost no nuclei and scar formation. This last condition might be called a "resting" stage.

CASE REPORTS

Case 1. In this case of Dupuytren's contracture of the plantar fascia operation had been performed and a diagnosis of a malignant lesion had been made prior to admission at the clinic. A waitress, 32 years of age, was seen in December, 1928, at which time she stated that about 13 years prior to examination she had slipped on a door sill and felt something give way in the right foot. A month later she had noticed a small mass in the arch of the foot which gradually increased in size and became painful. She further stated that about 7 years prior to admission operation had been performed; she had been informed that the condition was cancerous and amputation of her leg had been advised. After this operation the mass had grown more rapidly and a similar mass had appeared in the sole of the left foot. Two years later she had consulted another physician and had been advised to have her teeth removed as they were causing her trouble. The teeth were extracted without improvement in the condition. One year before she was seen at the clinic she underwent operation again and masses were removed from the arches of both feet. There was recurrence of the masses after this operation and subsequently she had received radium and roentgen therapy.

Examination disclosed irregular, hard masses adherent to the skin of the soles of the feet with scars from previous operations (Fig. 5). The roentgenograms of the feet and the results of the blood examinations and flocculation test were negative. Operation was performed and a large portion of the plantar fascia was removed from both feet. The tumorlike masses were ¾ inch (about 2 cm.) in thickness and were adherent to the skin. The pathologist found dense, fibrous, hyaline tissue. The convalescence was uneventful and the incisions healed with primary union. The patient was dismissed a month after operation.

Case 2. This patient with bilateral Dupuytren's contracture of hands and feet was a salesman 34 years of age. The bilateral Dupuytren's contracture of the hands and feet (Fig. 6) was of 18 months' duration. There was no history of trauma or hereditary factors in his case. He did not have pain. He preferred having operation on the left hand performed. This was done. The pathologist reported fibrous tissue.

Case 3. Dupuytren's contracture of the left foot with subsequent involvement of both hands and

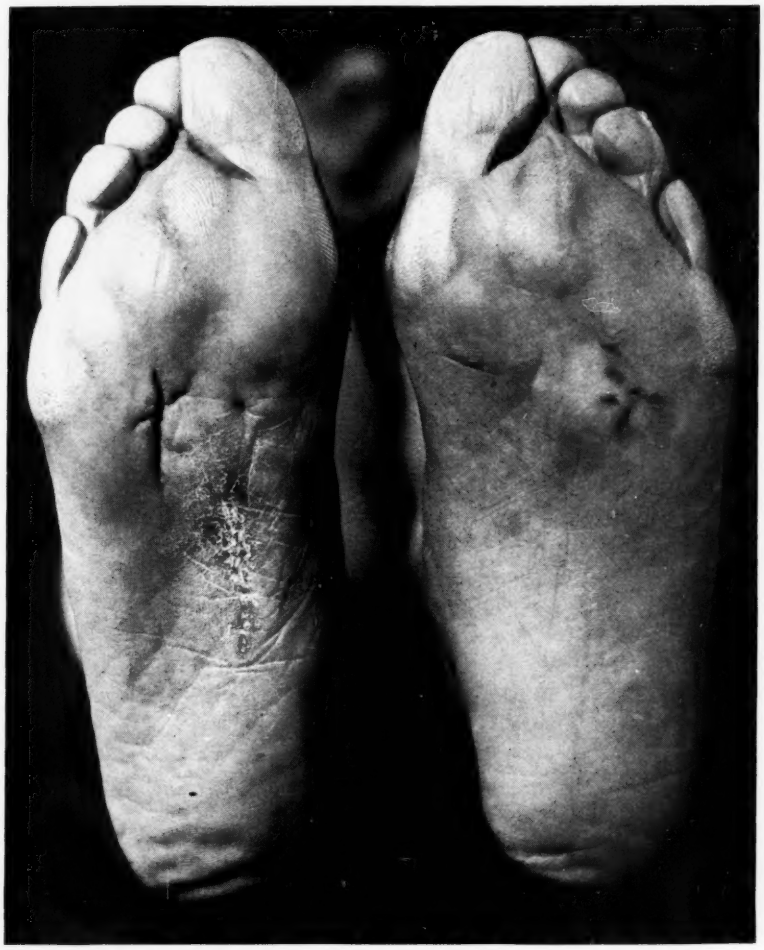

Fig. 5. Bilateral Dupuytren's contracture with hard, irregular masses and scars from previous operations (Case 1). A diagnosis of a malignant lesion had been made and amputation of the right leg had been advised.

the right foot occurred in a machine operator, 36 years of age. He was seen in 1945, at which time he gave a history of having dropped a 250-pound (about 113 kg.) weight on his left foot, crushing the left great toe, in 1939. He had undergone operation in 1940 and, because of persistent pain, amputation of the toe had been done in June, 1945. At the time of the latter operation, a tumor had been removed from the arch of the left foot and a diagnosis of fibroma or fibrosarcoma had been made. He stated, however, that he continued to have pain in the stump of the toe and arch of the foot which had interrupted his sleep, and he came to the clinic because of recurrence of the mass in the arch of this foot which had gradually increased in size.

We excised two neuromas from the digital nerve at the base of the left great toe. A hard, fixed tumor, 1½ inches (about 4 cm.) in length and 1 inch (about 2.5 cm.) in width, attached to the skin was found in the arch of the left foot. It involved the plantar fascia and was adherent to the underlying blood vessels, nerves and muscle. This mass was completely excised and the patholo-

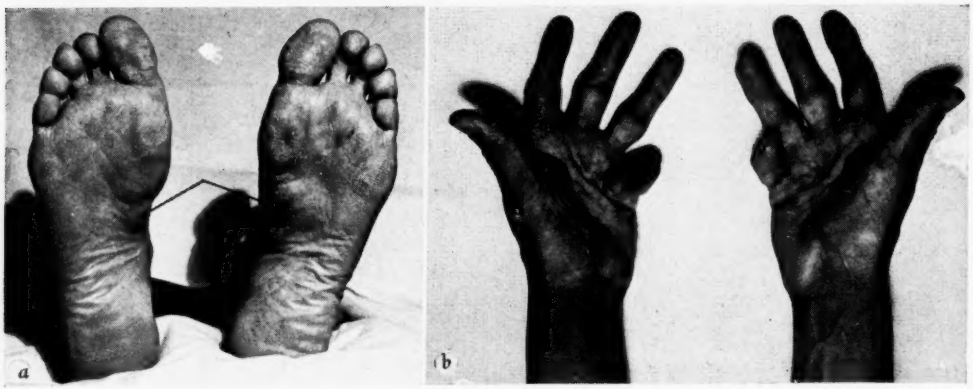

Fig. 6. a, Bilateral Dupuytren's contracture of the feet; b, bilateral Dupuytren's contracture of the hands in same patient (Case 2).

gist found nodular thickening of the plantar fascia with microscopic features of Dupuytren's contracture. The tissue from the great toe showed nerve tissue with neuroma formation. The patient was dismissed two weeks after his operation, at which time his incisions had healed with primary intention.

At the time when this paper was written, about two and a half years after operation, the physician at home reported that the patient showed evidences of Dupuytren's contracture involving the right foot and both hands.

SUMMARY

1. The feet were involved in 24 cases (approximately 2.7 per cent) of our series of 882 cases of Dupuytren's contracture in which the patients were seen at the Mayo Clinic in the period from 1928 through 1947. It is probable that if the clinicians had searched for the lesion in the foot more often, the incidence would have been higher.

2. The location of the lesion was usually on the plantar arch, proximal to the metatarsal heads. The average age of the patients was 39 years with the youngest one 13 years of age and the oldest 61 years of age. A history of trauma was obtained in 7 cases, and of hereditary factors in 2 cases. Twelve patients had an associated lesion of the hands and 12 had involvement of the feet alone.

3. In our opinion the best etiologic explanation of this condition is a chronic inflammatory process aggravated by trauma and function, heredity, senility and occupation being predisposing factors.

4. Care must be taken to differentiate this disease from fibrosarcoma, for which it may be easily mistaken if the microscopic section is taken during an active phase of the fibroblastic process. Round-cell perivascular infiltration, fibroblastic nodular proliferation, loss of areolar tissue and mitotic figures may be present.

5. The treatment of the disease is surgical excision of all of the involved plantar fascia.

SOMMAIRE

Dans 882 cas de maladie de Dupuytren pendant la periode de 1928 à 1947 inclus 24 cas intéressaient le pied. Il est probable que si les cliniciens avaient examiné plus souvent soigneusement les pieds, l'incidence aurait été plus élevée. Les lésions sont généralement situeés à l'arcade à plantaire à proximité de la tête des métatarses. L'âge moyen des malades était de 39 ans et le plus jeune avait 13 ans: le plus vieux l'âge de 61 ans. Dans 7 cas le lésion but précédée d'une traumatisme; dans 2 cas, il existait des facteurs héréditaires; 12 avaient une lésion associée des mains et dans les 12 autres la lésion était limitée aux pieds.

C'est notre opinion que l'explication étiologique de ces conditions est un procédé inflamatoire chronique aggravé par le trauma, par l'hérédité, la sénilité et l'occupation du malade.

Il faut différencier cette condition du fibrosarcome avec lequel elle est souvent con-

fondue. Il faut faire un examen d'une section microscopique pendant la phase active du procédé fibroblastique.

On peut rencontrer une prolifération des cellules rondes, une prolifération fibroblastique nodulaire, une perte de tissue aréolaire et des figures mitotiques.

L'excision chirurgicale de tout fascia plantaire attaqué est indiquée.

SUMARIO

En una serie de 882 casos de contractura de Dupuytren los pieses fueron afectados en 24 de los pacientes (2.7% aproximadamente). Esta serie que cubre el periodo de 1928 a 1947 inclusive posiblemente habria mostrado una incidencia mayor en las lesiones del pie si los clinicos hubieran prestado mas atencion a este miembro.

Las lesiones generalmente se encontraron en la superficie plantar de las cabezas de los metatarsos. La edad de los pacientes presento un average de 39 años, sin embargo el mas joven fue un caso de 19 años y el mas viejo fue 61. En 7 casos se obtuvo una historia de trauma y 2 presentaron factores de herencia; en 12 las lesiones ocurrieron solamente en el pie, y en otros doce casos ocurrieron en asociacion con contracturas de la mano. En nuestra opinion la mejor explanacion etiologica de estas lesiones es la inflamacion cronica la cual es agravada por el trauma y el uso; la herencia, la senilidad y la ocupacion del paciente son factores etiologicos predisponentes. En el estudio de las secciones microscopicas se debe de tomar cuidado de no confundir estas lesiones con el fibrosarcoma especialmente durante la fase activa de proliferacion fibroblastica. El tratamiento es quirurgico y consiste de la excision de toda la aponeurosis plantar que este afectada.

RIASSUNTO

Sopra 882 casi di contratture di Dupuytren esaminati nella clinica dal 1928 al 1947, in 24 casi (all'incirca nel 2,7%) la contrattura interessava i piedi. E' probabile che la percentuale sarebbe stata anche piu' elevata, se i medici avessero indagato con maggiore diligenza. La sede della lesione corrisponde generalmente all'arco plantare, in una zona prossimale alle teste del metatarsi. L'eta' media dei pazienti e' di 39 anni; il piu' giovane aveva 13 anni: il piu' vecchio 61. In 7 casi esisteva nell'anamnesi la storia di un trauma: in 2 casi dei fattori ereditari. In 12 casi la lesione dei piedi era associata ad una lesione consimile delle mani: in 12 era invece limitata ai piedi.

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The Knee Joint

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THE knee joint is a mechanical unit, like a watch, an automobile or a machine gun. Any disturbance of one part of the unit affects the working of the apparatus as a whole. The knee is actually a poorly fitting joint. A cabinet maker might not acknowledge having made it, but he would boast about its performance. I shall describe in a simple way the development of the knee joint.

Nature put together the ends of the two longest bones in the body, the femur and the tibia. When bone meets bone, it makes a joint, providing it can find a capsule to surround the union. Because a joint needs lubrication, nature put a secreting lining in the capsule, which is called the synovial membrane. Still, the knee was a poor joint, with practically no freedom of movement. Nature, therefore, pulled the bones apart. Since they would not stay apart, she inserted two semilunar cartilages, first to act as joint spreaders, then as cushions and brake shoes. Still the bones had no force for movement; therefore, nature surrounded the joint with some of the strongest muscles in the body. She had to have more external stability, so she added the tibial and fibular collateral ligaments. There had to be internal stability to prevent excessive movements, so she interposed the anterior and posterior crucial ligaments. As though she had not solved one of her toughest mechanical jobs, nature added a patella, a fat pad and a group of bursae. The fibula makes another nearby joint.

As an indication of nature's success, I cite the fact that automotive engineers have paid her a great compliment when they applied the knee-action principle to automobiles.

Unlike the hip and shoulder, which have universal movement, the knee has a pure hinge motion with two supplementary components: (1) sliding and (2) rotation.

The great length of the femur and tibia throws tremendous leverage stress and strain upon the structures of the knee.

The knee joint is man's largest synovium-lined cavity. The biomechanics is not perfectly designed for its functional usage. The joint was constructed for the four-footed position and not for one in which the lower end of the femur bears directly in a vertical manner upon the upper end of the tibia. This change was brought about by the assumption of the upright posture. The elephant is said to be the only other animal whose hind legs are used with the femur vertically opposed to the tibia. The articular cartilage of the knee joint presents the largest surfaces of this kind in the body. These surfaces in health are smooth as a billiard ball and lubricated by synovial fluid, so that the complicated movements of flexion and extension are accomplished in a smooth, gliding manner. With the slightest variation of the smoothness of these articular cartilages, the surfaces begin to rub and grate.

In addition to being the largest joint in the body, the knee is the most frequently affected and infected.

Knee disturbances may be due to congenital, traumatic, static, metabolic, allergic, neoplastic and infectious causes. Lesions of the knee joint may be divided into internal and external derangements.

A miscellaneous group of conditions which might affect the knee includes hip conditions, abnormal conditions of the foot, intrapelvic lesions, hysteria, and endocrine disturbances.

Pathologic changes may be found in the bones, cartilage, synovial membrane, capsule, menisci, lateral ligaments, tibial spines, crucial ligaments, bursae and tendons.

Primary pain in the knee means a discomfort that originates in or around the bones, joints, synovial membrane, ligaments, fasciae, nerves and blood vessels. Secondary knee conditions may be produced by a focal infection in the gastrointestinal, genito-urinary or respiratory tracts, having toxic or infectious effects on structures in or around the knee. Removal of the primary cause may fail to cure the secondary lesion.

The examiner should be on his guard in

obtaining histories and while examining all patients when an industrial, traumatic, military or medicolegal aspect is involved. Industrial, compensation, and medicolegal aspects of such disorders as internal derangements of the knee, injuries to the internal and external ligaments, fractures and dislocations present special problems of diagnosis and treatment.

The prognosis in knee lesions should always be guarded. It depends upon the etiologic factors, pathologic changes, duration of the condition, persistence of the treatment, and the question of financial or other compensation.

Most of the chronic, unstable, incompetent knees that are seen from day to day could have been prevented if the first physician had made a correct, specific diagnosis and had instituted appropriate treatment immediately.

In certain cases the period of disability bears a direct relation to the duration of symptoms prior to operation. The guiding principle should be, "Early operation where an operation is, or undoubtedly will be, indicated."

Joint effusion which is an evidence of irritation of the synovial membrane may prolong convalescence.

Restoration of function and earning capacity with freedom from pain are the crucial points to be considered in determining the value of any procedure.

Knee injuries may be followed by a train of nervous symptoms which are out of proportion to the severity of the injury. Litigation or military reclassification makes the problem more complicated. The knee is a frequent retreat for slackers, exaggerators, and malingerers. Injuries even to normal knees may require long periods of recovery.

I am impressed with the analogy of knee and back disorders. Some of the points of similarity are: mechanical derangements, internal derangements, subjection to repeated injuries, vulnerability and multiple injuries.

Owing to world war and industrial and athletic activities, there has been awakened world wide interest in physical fitness. The knee is an important factor in this program. Examples of this are found in paratroopers and ski troopers. The knee problem is one of the most important during basic military training. In one army general hospital where I served, there was a period when I had seven knee cases to one foot case, one knee case to every back case, and one knee case to every fracture case.

Every so often a patient will say, "Doctor, I'm afraid to have my knee operated on because my best friend had a stiff knee following his operation."

The chief possibilities are:

1. The surgeon might have performed a fusion purposely.
2. It might not have been operated on soon enough.
3. Infection might have occurred.

Recent advances have been made toward a clearer understanding of lesions involving the menisci, the ligaments and the patellofemoral mechanism and in a standardization of surgical approaches as well as operative technics. The addition of modern chemotherapeutic agents to the established knowledge of asepsis and antisepsis has made surgery of the knee joint a very important and interesting subject.

There have been several outstanding contributions to the understanding of knee disorders during the past ten years. Most noteworthy are those of Voshell and Brantigan, Palmer, Friberg, Cave, Bosworth, Soto-Hall, West, Smillie and Abbott and his colleagues.

A turning point in the understanding of the ligaments by American orthopedic surgeons came when Brantigan and Voshell demonstrated their work on the biomechanics of the knee. In addition to their important contributions their studies stimulated much interest and research.

If a sufficient number of investigators discover the answers to one or two problems, there will come a time when the entire subject will be conquered.

The most important injuries of the soft tissues in and around the knee joint are:

1. Lacerations of the anterior and posterior crucial ligaments.
2. Tears of the collateral ligaments.
3. Lacerations of the synovial membrane.
4. Rupture of the capsule.
5. Trauma to the bursae about the joint.

Injuries to the synovial membrane are not very extensive unless the knee joint has been punctured by a foreign body or ruptured by a fracture into the joint. In the absence of

infection, the membrane heals readily and without much limitation of joint motion.

The quadriceps muscle is the watchdog of the knee. It is the captain, quarterback and backfield of the knee's defense. At Mayo General Hospital I posted in every orthopedic ward a large sign which read:

HAVE YOU EXERCISED
YOUR QUADRICEPS TODAY?

It was very effective.

In the nonoperative treatment of serious injuries I emphasize the advice "early to bed" and maintain the tone and power of the "quadriceps extensor," if you wish "early to rise." In cases of injury to the knee joint no skeletal muscles lose tone as quickly as the quadriceps does. For this reason, precise instructions should be given to every patient before and after operation to retain and regain muscle tone. Electrical stimulation, especially by sinusoidal current, will supplement active movement and other physical therapy to retain and regain tone.

In many cases quadriceps exercises should be started several days before an operation and resumed immediately after operation.

The success of any operative procedure to repair the internal or external ligaments depends to a considerable degree on the power of the quadriceps muscle.

The knee situation boils down to:

1. Diagnosis
2. Surgery

of

- Mechanical
- Traumatic
- Infectious
- Neoplastic
- Arthritic
- Metabolic
- Neuropathic

disorders

10 COMMANDMENTS OF KNEE SURGERY

1. Always take sufficient time to get an accurate and complete history.
2. Make a complete physical examination—include feet and pelvis.
3. Demand perfect x-rays in various projections.
4. In mechanical disorders be sure to make an accurate survey of the biomechanical difficulty and correct it.
5. In infectious lesions be sure to use penicillin and other chemotherapeutic agents to the optimal point.
6. In traumatic cases be sure of normal alignment of the leg.
7. In neoplastic cases be sure to differentiate benign from malignant lesions and consult the radiologist regarding radiosensitivity of the lesion.
8. In metabolic lesions be sure to get the patient in optimal weight balance.
9. Be conservative but once surgery is required, do not delay.
10. Never fail to consult, in doubtful cases, with the roentgenologist or radiologist.

If the medical profession could be taught to place under proper surgical care patients with internal derangements of the knee, before they develop relaxation of the muscles, it would be a great step forward.

Some of my original conceptions have become convictions: (1) The term "internal derangements of the knee" had become a diagnostic dumping ground. The proximity of tissues and structures is no excuse for mass diagnosis. (2) Greater strides will be made when the best possible differential diagnoses are made during the immediate acute stage. (3) Exact anatomic diagnosis in acute injuries of the knee is of the utmost importance. (4) One should not attempt to reduce a displaced semilunar cartilage without full obliteration of pain and complete relaxation of muscle spasm. (5) Good collateral ligaments minimize the inadequacies of the crucial ligaments. (6) A strong quadriceps muscle makes up for considerable deficiency of the injured crucials and collaterals. (7) There is too much "brutal" manipulation of the knee. (8) Although there is no doubt that some internal and external ligaments of the knee have healed perfectly, early operation is preferred in those cases where a precise diagnosis can be made.

ANATOMIC FACTORS

Meniscus. The use of the term cartilage for a meniscus is confusing. I limit the term cartilage to the articular hyaline cartilage. I prefer the term meniscus for the structure semilunar cartilage. The plural of meniscus is meniscuses or menisci. Both meniscuses

are internal, meaning intraarticular; one is medial; the other is lateral.

The knee joint contains two crescentic fibrocartilages called the medial and lateral menisci. They are buffers placed at the rim of the joint and help to deepen the sockets with which the femoral condyles articulate. They are moving wedges, which prevent displacement, especially laterally. They function normally until forced between the bones by rotation or until caught therein by some unusual movement of the knee. They are the shock absorbers which deepen the sockets on top of the tibia. About two-thirds of the surface into which the femoral condyles fit has this "bushing" covered with membrane. The menisci are important, not only as shock absorbers, but also because of their wedge action. They are like brake shoes on a wagon or carriage. If one attempts to push the tibia sideways on the femur, he will find the condyles running up on the sides of the menisci. The higher the condyle rises on the meniscus, the tighter the ligaments become and the more firmly the knee is held.

The menisci cushion the articular surfaces of the femur during hyperextension and hyperflexion.

The medial meniscus is almost semicircular and is attached in front in a thin pointed margin to a depression on the head of the tibia just in front of the anterior crucial ligament. Behind, it is attached to a depression back of the tibial spine between the attachment of the lateral meniscus and the posterior crucial ligament. The lateral meniscus, almost circular, is larger than the medial and has a groove on its lateral side for the popliteus muscle. The anterior end is attached to the front of the tibial spine behind the anterior crucial ligament, with which it blends; the posterior end is fastened behind the tibial spine in front of the rear attachment of the medial meniscus. It gives off a strong fasciculus to be attached to the medial condyle of the femur, close to the attachment of the posterior crucial ligament. In front it gives off another band known as the transverse ligament. The medial meniscus is more vulnerable than the lateral because the latter is larger, more nearly circular, is grooved for a muscle, and its attachments in front and behind are better protected. It also has two fasciculi which serve as ligamentous anchorages. A mechanical weak spot exists where the movable anterior portion joins the comparatively fixed posterior portion of the meniscus.

The lateral meniscus is more circular, and its horns are attached to the tibia, one on each side of the tibial spine. The posterior horn usually has a strong ligamentous attachment to the posterior cruciate ligaments.

There is a groove on the peripheral aspect of the lateral meniscus where the popliteus tendon passes across it. The tendon prevents any close attachment between the lateral meniscus and the fibular collateral ligament, so that, in contradistinction to the medial meniscus, the lateral enjoys a considerable range of movement. Further, it moves as a whole, and there is no weak point between a movable and a fixed portion, as there is in the case of the medial meniscus.

The menisci further the adaptation of the tibial socket to the femoral condyles, they assist the lateral ligaments to check or prohibit exaggerated lateral movement of the joint and help in torsion movements of the knee.

Fisher has demonstrated that there are two nutritional zones in each meniscus; the peripheral is well vascularized, whereas the central zone is practically devoid of blood vessels and derives its nourishment from the synovial fluid.

Plica Articularis. The plica articularis is a membranous section of tissue forming a transverse partition that divides the suprapatellar portion of the synovial sac into compartments. It also forms a synovial pouch or pocket that may harbor loose bodies. It can produce symptoms that resemble those of meniscus derangements.

This embryologic remnant is important during aspirations and injections of the knee joint and explains some of the dry taps that are so disturbing to the surgeon.*

It explains

1. Many dry taps.
2. Failure to find loose bodies.
3. Pocketing of infections.

* I have observed it several times when I employed the Krida approach.

CLASSIFICATION OF KNEE DISORDERS

The subject of knee joint disturbances is readily divided into two groups—internal and external derangements.

Internal derangements include the following:

1. medial meniscus disorders
2. lateral meniscus disorders
3. crucial ligament rupture
4. tibial spine fractures
5. synovitis
6. arthritis
7. chondromalacia patellae
8. patellofemoral lesions
9. osteochondritis dissecans
10. osteochondromatosis—rice bodies—Hoffa's lesion of fat pad—lipoma arborescens
11. intermittent hydrarthrosis
12. bursitis—cysts
13. hemophilia
14. hemorrhage into the joint

External derangements include the following:

1. fracture of the patella
2. dislocation of the patella
3. quadriceps tendon rupture
4. quadriceps tendon adhesions
5. patellar tendon rupture
6. Osgood-Schlatter's lesion
7. bursitis—cysts
8. ruptured lateral ligaments
9. relaxed ligaments—Pellegrini-Stieda's lesion
10. tendinitis
11. fibrositis
12. miscellaneous conditions

ETIOLOGIC FACTORS

The most common mechanism in knee injury is the following:

1. Foot stops and becomes fixed
2. Body goes on
3. Knee flexes
4. Lateral thrust { a. intrinsic / b. extrinsic } or
5. Inward rotation of femur
6. Outward rotation of tibia
7. Extension of knee { a. attempted / b. completed } or

These are especially applicable to the menisci.

SYMPTOMS OF KNEE DISORDERS

The most important symptoms of knee disturbances are *discomfort, deformity* and *disability.* The chief symptoms are pain, limitation of motion, swelling, tenderness to touch, sensitiveness to movement, locking, crepitus, weakness and undependability. The pain usually is local. Weakness and buckling may be due to many factors, including pain. For the purposes of history taking the various

COMPLAINTS OF PERSONS WITH KNEE DISORDERS

Pain	Pinching
Locking	Grating
Catching	Grinding
Swelling	Crackling
Stiffness	Crunching
Weakness	Pulverizing
Lameness—limp	Giving way
Fatigue	Buckling
Insecurity	Crumpling
Undependability	Inability to kneel
Instability	Inability to crawl
Frequent twists	Deformity
Snapping	Weather changes
Clicking	Postinertial dyskinesia
Crepitus	

Specific Questions Regarding Present Injury

NATURE OF INJURY

- Direct violence
- Indirect violence
- Fall
- Twist—squeeze
- Overextension
- Squatting
- Walking
- Running
- Lateral force

MECHANOGENESIS

- Position of leg
- Application of force
- Rotation of lower leg
  - clockwise
  - counter-clockwise

INTERROGATION REGARDING PAIN

- Location
- Referred
- Constant
- Intermittent
- Dull or sharp
- Aggravated by .....?
- Relieved by .....?
- Diurnal variation in intensity
  - during day
  - during night

INTERROGATION REGARDING "LOCKING"

- Instantaneous
- Continuous
- Intermittent
- Reduction
  - Spontaneous
  - Easy
  - Difficult
  - By whom
  - How

LIMITATION OF MOVEMENTS

- Flexion — Degree
- Extension — Degree

SWELLING

- Location
- Degree
- Kind
- Persistent

STABILITY OF KNEE

- Hypermobility—excursion of tibia:
  - forward
  - backward
  - laterally
  - medialward
- Wobbliness
  - slipping
  - snapping

complaints of persons with knee disorders may be charted as in the accompanying chart. Specific questions in history taking also may be charted as shown on page 609.

METHODS OF EXAMINATION

The physical examination must include the location of pain and tenderness, presence of swelling, limitation of motion, laxity and pain on precise movements or maneuvers, and tests of the joint.

A general minimal examination includes tests of reflexes, and sensations, examination of the feet, and the balance of the pelvis. A line drawing of the knee, with abnormal areas indicated, preferably in color, should be attached to every office, hospital and dispensary record.

The occurrence of pain and its exact site are of importance, and the joint must be very carefully palpated to localize any area of tenderness. The stability of the lateral and crucial ligaments must be tested, and the full range of painless movement carefully measured. The whole surface of the joint should be palpated while the patient flexes and extends it through its fullest possible range.

The following outline is amplified from an earlier article of mine published elsewhere.*

Routine sequence of examination of the knee comprises inspection, palpation, auscultation, neurologic examination and special tests.

INSPECTION

Standing
- Can patient stand unassisted?
- General appearance of knee
- Deformity? flexion+genu valgum+genu varum +genu recurvatum+torsion
- Anatomic location of affected area, as indicated by patient
- Normal landmarks: visible—obliterated
- Swelling (generalized, localized)
- Atrophy (quadriceps, calf)
- Does he tire quickly, while standing?
- Areas of pain
- Tenderness to pressure
- Sensitiveness to movements
- Is the quadriceps outline normal? Gap?
- Is the tibial tubercle normal?
- Valgus thrust: A thrust against the lateral border of the knee while it is flexed and in knockknee position.
- Resistance test: Kicking heavy objects of furniture around the room.

Sitting
- With knees flexed over side of examining table
  - Locking?
  - Degree of free movement
  - Degree of forced movement
  - Palpable crepitus (coarse, fine)
- With knees extended on examining table
  - General appearance of knee
  - Is the knee held in a flexed position?
  - Is the skin over the injured knee warmer than that over the other?
  - Other signs of inflammation?
  - Specific tender areas
  - Can patient squeeze examiner's hand against the table by forcibly extending his knees?
  - Is the patellar outline obliterated?
  - Is there a swelling?
  - Is it due to:
    - excess fluid
    - inflammation
    - hemorrhage
    - thickened membrane
  - Joint synovial distention
  - Bursa distention
  - Free fluid (+) or (—)
    - ("Milk" the lower thigh toward the knee)
    - Is it in the joint or in a bursa, especially suprapatellar?
    - Is aspiration indicated?
  - Patella
    - Mobility? Laterally? Longitudinally?
    - Does it float?
    - Crepitus
    - Can you pick up capsule above patella?
  - Loose bodies
  - Blow on the heel, transmitted to knee
    - Does it produce pain?
  - Areas of pain
  - Tenderness to pressure
  - Sensitiveness to certain movements.

Walking
- Can patient walk without assistance?
- Does he need crutches or cane?
- Does patient limp?
- Does he walk on toes of affected leg?
- Does the knee buckle?
- Does he take steps of equal length?

Lying (supine and prone)
- Knees extended

* Illinois M. J., January, 1927.

Sitting

Knees flexed Drawer sign {Anterior / Posterior}

Kneeling

Can patient kneel on a chair?
Is it painful?

Squatting

Can patient squat down between his heels?
Is it painful?

Does it produce crepitus {palpable / audible}

PALPATION

Skin temperature
Character of swelling
Tender spots
Free fluid
Thickened membrane

AUSCULATION

Crepitus

NEUROLOGIC

Every physician should be able to make a neurologic examination. The equipment is simple: a percussion hammer, a pin, a wisp of cotton, a fountain pen or skin-marking pencil to outline skin areas, a test tube with hot water, another with ice water, and a tuning fork.

I have divided the subject into the following sections:

1. Station
2. Attitude
3. Ataxia
4. Gait
5. Coordination
6. Motor power: strength—range of movement
7. Reflex activity
8. Sensation: sensorium—tuning fork
9. Trophic changes
10. Local defects and lesions
11. Special clinical and laboratory tests
12. Spinal puncture is performed only in selected cases.

The examiner determines first whether the patient can voluntarily put his feet in dorsiflexion, plantar flexion, pronation and supination; second, whether these movements can be made passively; third, whether they can be made against resistance; fourth, whether the patient can feel the touch of the hand on all areas of the skin, and whether he can differentiate between the sharp and dull ends of a pin, between the sensation of a wisp of cotton and the stroking of a finger and between heat and cold applied by means of test tubes containing cold and warm water. The presence or absence of the Babinski reflex is determined by stroking the sole of the foot along the outer border. The proprioceptive sense is determined by moving the toes up and down and sidewise. Ataxia can be easily demonstrated. Sensory changes in leg, foot and toes. Motor power in muscle group of thigh, leg, foot and toes. Reflexes of quadriceps and tendo achillis.

SPECIAL TESTS

1. Specific tests for meniscus lesions:
   Flexed knee
   Tender spots
   Palpable meniscus, out of normal location
   Knock knee thrust
   Bow leg thrust
   Palpable cyst of meniscus
   Fouche—Apley
   McMurray

MEASUREMENTS	RIGHT	LEFT
At groin		
Mid-thigh		
1 inch above patella		
Around patella		
Garter line		
Around calf		
Above ankle		

2. Specific tests for crucial ligament lesions:
   - Leg hanging over table
   - Drawer sign or test
     - Anterior—forward excursion of tibia
     - Posterior—backward excursion of tibia
   - Lewin test—patient prone-lying, flexed knee position, drawer sign.

3. Specific tests for lateral ligament lesions
   - Knock knee thrust
   - Bow leg thrust
   - Locking patient's foot and leg between examiner's knees and applying lateral hand-pressure against knee
   - Torsion test forcing the lower leg
     - Clockwise
     - Counter clockwise

4. Test of stability and muscle power
   - Can the patient step up on a chair or stair using the affected knee?

5. Special tests for
   - Arthritis
   - Synovitis

Galeazzi devised an arthrogoniometer for measuring deviations of the knee. The ordinary protractor is used to measure degrees of movement.

Examination of the Popliteal Area. It is a revelation to any examiner who tries for the first time to examine the contents of the popliteal region if he places the patient on the table in a prone-lying position and flexes his knee. The degree of relaxation of the tissues of the thigh, popliteal space and calf is surprising. The ability to palpate specific structures is remarkable, especially:

- posterior capsule
- bursae
- posterior portions of the menisci
- popliteus muscle
- tendons {inner / outer} hamstrings
- aneurysm
- pulse
- nerve
- crucial ligaments

Hypermobility.	Forced movements
Anteriorly	
Posteriorly	
Medially	
Laterally	
Car wheel excursion	

Joint Movements	Active (degrees)	Passive (degrees)	Forced	Spasm	Areas of Tenderness
Flexion					
Extension					
Tibia forward					
Tibia backward					
Tibia laterally					
Rotation					
Forced					
Clockwise					
Counter Clockwise					

Examination Under Anesthesia. Short anesthesia by intravenous pentothal sodium is being employed with greater frequency in cases of injuries to the knee. This examination may be more enlightening than x-rays in some conditions. In ligamentous injuries it is of greater positive value than x-rays. In meniscus lesions, the displaced meniscus may be replaced while under this drug. Its greatest value is in the determination of ligamentous rupture. Among the important purposes accomplished are: (1) Relief from pain; (2) relaxation of muscles, by knocking out the watch dog action of the quadriceps. Naturally, the surgeon will attempt to replace any displaced structures.

Joint Thermometry. Putti and Casuccio state that the determination of the local temperature of a joint is of value both in diagnosis and prognosis.

In a number of cases the deep temperature of the joints, measured with Zondek's deep thermometer, was found to be several degrees higher than the surface temperature.

In all acute diseases of the knee joint, tuberculosis, tumor, and juxta-articular osteomyelitis, there is a rise of temperature. In Putti's series of nontuberculous arthritis, the rise of temperature was less than in the tuberculous cases.

CLINICAL SIGNS OF KNEE DISORDERS

No one sign is pathognomonic of a specific disease or lesion. Only by the evaluation and integration of all the symptoms, signs and tests can a reasonably accurate diagnosis be made, first, in respect to the anatomic structures involved, and second, in determining whether it is an infectious, traumatic, mechanical or other type of lesion. There is no one test that "makes or breaks" the diagnosis, and there is no one test that always determines the exact localization of a lesion or injury.

The term "locking" is often used to describe difficult extension of the knee due to sprain, whereas it should mean an insurmountable wedging of the joint. Locking can occur from a nipped loose body pedunculated or otherwise, from blocking of a tibial spine, from a slipping of a hamstring over an osteoma, or from a slipping of biceps over the head of the fibula.

The value of the drawer sign has been seriously questioned because of its variability and uncertainty. Stability may be lost by atrophy due to locking, sprain or effusion. It will be particularly noticeable if the joint is fixed for a considerable period after the surgical treatment of some complication as when the joint has been tapped or has been operated upon. It may be overshadowed or obliterated by any kind of "locking" due to pinching. The articular surfaces then separate from each other, the ligaments become tense, and the muscular tone increases through the additional irritation caused by pinching. The drawer sign may lead to erroneous conclusions.

Internal Rotation of the Tibia. This maneuver was first demonstrated by Fouche. According to Dutoit and Enslin, the test is carried out on the right knee, with the patient flat on his back on a couch, with his hip and knee fully flexed. The left fingers of the examining surgeon are held on the anteromedial joint line, the right hand firmly grasping the patient's right foot, which is used as a lever in internally rotating the tibia on the femur. The motion is carried through as a complete circumduction movement, starting with the knee fully flexed, and ending with it slightly flexed. The menisci move with the tibia, and the posterior end of the medial meniscus is nipped between the femoral and tibial condyles, the tendency being for the femoral condyle to force the meniscus toward the center of the joint. It may move a small distance, and then slip back, producing an audible and palpable thud. With practice, one is able to recognize this normal thud, and to distinguish it from other sounds. The sound which may be elicited from a torn meniscus is a crunch or squelch; from a narrow bucket-handle strip of cartilage, a high-pitched click; or from multiple splits in the posterior part of the meniscus, a succession of clicks. A broad rim of meniscus which is partly loose may cause only exaggeration of the normal thud; while the reduction or the dislocation of a wide bucket-handle portion causes a loud crack and a jolt.

External Rotation of the Tibia. The maneuver for internal rotation of the tibia is reversed for the detection of lesions of the posterior half of the lateral meniscus. For this purpose it has been found to be of considerable value.

Manipulation of the Knee in 20 Degrees of Flexion. This maneuver is carried out with the patient's knee relaxed. The examiner puts one hand on either side of the joint, and circumducts the knee in a small circle, meanwhile holding his thumbs on the joint line on either side. By this method it is often possible to elicit thuds or clicks due to tears situated farther forward, near the anterior attachments of the menisci.

Crushing Sign (Apley). In testing for laxity of the collateral ligaments, pain may be elicited over a torn medial meniscus by adduction of the tibia on the femur as a result of crushing the torn tissue. Abduction may cause pain when the lateral meniscus is torn.

Roentgenographic Examination. This is a routine part of the clinical examination and is essential to accurate diagnosis.

Roentgen findings usually are negative. A negative film is contributory evidence of meniscus disturbance. In an uncomplicated case of medial meniscus disturbance, the roentgenogram should show nothing positive. A meniscus does not reveal itself in a roentgenogram unless it is ossified, calcified or visualized by injection of air, gas, or other opaque substance. It is frequently noticed that the space between the medial condyle of the femur and the medial tuberosity of the tibia is narrower than the corresponding space on the lateral side.

Lagegren reports his roentgenographic studies of the knee with the use of 20 cc. of a 17.5 per cent solution of perabrodil. With this opaque substance and by a simple technic, he was able to demonstrate meniscal injuries in clinically uncertain cases. It was possible also to make a diagnosis of the type and extent of the damage which was subsequently confirmed by the operative findings.

DIAGNOSIS

The diagnosis of knee lesions is made from the combination of a careful history and complete physical and roentgen ray examinations. One must differentiate between lesions caused by injury and preexisting conditions which are aggravated by injury.

At this point I wish to emphasize precision in diagnosis. I make a plea for immediate exact anatomic diagnosis in acute injuries of the knee. Early diagnosis will lead to early appropriate treatment which automatically minimizes disability. It is possible to observe clinical syndromes precisely, in localization and pathologic anatomy in knee lesions. Keen diagnostic ability is required. One must be willing to take the time to obtain an accurate and complete history and to make a meticulously careful examination. One must be proficient in the interpretation of routine and special roentgen ray projections.

A consideration of the history of injury, mechanism of injury, locking of the knee in flexion, pain, disability and a point of tenderness unexplained by roentgenograms made in three projections is essential. Important conditions to be considered are: (1) A loose body, such as found in osteochondritis dissecans or osteochondromatosis; (2) a traumatic synovitis; (3) traumatic arthritis; (4) injury to the crucial ligaments; (5) pinching of the synovial membrane.

DIFFERENTIAL DIAGNOSIS

An accurate differential diagnosis is imperative in order to institute appropriate treatment. It is necessary to know the cardinal symptoms and signs, and the characteristic physical and roentgen manifestations of all injuries, lesions, deformities and diseases that might affect the knee. Unlike causes may produce similar symptoms, physical manifestations, pathologic changes and roentgen appearances.

The most important conditions to be differentiated are injuries, infections, arthritis, neoplasms, synovitis and osteochondritis. Exact location of the lesion during the early stage demands skill and painstaking study. The structure affected must be differentiated, i.e., the bones, synovial membrane, menisci, ligaments, or bursae. Involvement of the ligaments is difficult to determine because of

their close association anatomically and physiologically with other structures. No single sign or test is pathognomonic or infallible.

Consistent localized points of pain and tenderness, determined by palpation, are important. Too much reliance should not be placed on roentgenograms.

Important questions are: Is the evidence obtained from the history and the physical examination, as well as from the roentgenograms and other laboratory studies, compatible with a certain condition, even though not entirely conclusive? Is the roentgen evidence confirmatory or conformatory?

Trauma to the Knee. Injuries of the knee joint constitute an important problem in industrial surgery because of their frequency and the protracted periods of disability to which they often give rise.

One of the most important single aids to the diagnosis of injury to the knee joint is the history. *Do not be in a hurry to make the physical examination.* The history that precedes (or antedates) the episode in question is of vital importance. Many patients unwittingly mislead the doctor in regard to the degree and duration of pain. The patient's condition before the alleged trauma should be ascertained. The normal knee is resistant, but the predisposed knee is susceptible to various lesions. A person with intermittent attacks of disorders of the knee will try the surgeon's diagnostic ability. There should be a minute and exact account of the mechanism of injury and subsequent course.

The mechanics involved in every stage of the injury should be stated:

Was it a leverage mechanism?
Was it a direct blow?
Was it a concussion type?
Was it a compression injury?
Was it a contra-coup injury?
Was it a crushing injury?

A preexisting condition may be aggravated by a slight injury. The patient may have had the condition for a long time and a slight injury accentuates the pain and temporarily causes an increase of symptoms. Differentiation must be made between lesions caused by a specific injury and preexisting conditions which are aggravated by that injury.

Fractures or dislocations of the knee are diagnosed from the history, examination and roentgenograms. A fracture always has a history of injury even though the trauma may be slight. It usually causes localized pain. Roentgenograms reveal the fracture or dislocation.

Multiple injuries require careful analysis. It is not sufficient to diagnose a lesion which might cause the signs and symptoms under consideration; a complete examination is necessary even though pain and spasm may require an anesthetic to permit a careful study.

Injury to the Alar Pad of Fat. True locking is absent. Full extension is painful, but tenderness can be elicited by pressing on the pad, and the examiner gets the sensation of something slipping between the fingers. This structure is tender.

Rupture of the Tibial Collateral Ligament. Trauma usually produces an abduction rather than a rotary mechanism. There is no history of locking. There is tenderness usually over the tibial, but sometimes over the femoral attachment. Undue lateral mobility is demonstrable while the knee is extended or slightly flexed.

Rupture of the Cruciate Ligaments. In rupture of the anterior cruciate ligament, the tibia can be displaced forward on the femur, even though the knee is fully extended. In rupture of the posterior cruciate, the tibia can be displaced backward on the femur when the knee is flexed to a right angle. If these findings are present, a careful comparison should be made with the normal side, as many persons possess unduly mobile knees.

Fracture of the Patella without displacement can be diagnosed by a consideration of the points of tenderness on pressure, and by x-ray appearance.

Recurrent Dislocation of Patella. The quadriceps is lax, and when the knee is examined extended on the table, it is easy to push the patella over the outer femoral ridge.

Fracture of the Tibial Spine. The injury required is usually severe, and the mechanism of the strain is not a rotatory one. Sharply localized tenderness over the attachments of the semilunar cartilage is not present. Locking is present but assumes the form of a bony

block to movement. The fracture usually is seen on roentgenographic examination, especially in the Holmblad projection.

Derangements of the Menisci. A typical history of injury with locking followed by joint effusion and joint tenderness directly over the medial meniscus is not always obtained. Locking is not a necessary symptom. "Bucket-handle" fracture is the most consistent cause of locking.

Adhesions. The formation of adhesions following an injury or tear about the attachments of the meniscus is common. It is not possible in any given case which presents signs of adhesions to exclude an injury to the meniscus which will subsequently recur and require operative attack, even when the adhesions have been satisfactorily dealt with by forcible manipulation.

Slipping tendon may give rise to symptoms of locking, but the lock is momentary and is easily reduced by the patient himself. No joint effusion follows, and the tenderness over the joint line is absent. The roentgenogram may show the exostosis over which the tendon slips.

Traumatic neurosis is a diagnosis easily made but hard to prove. Malingering may be suspected from the general behavior of the patient. It is wise to approach the history from various angles. One cannot convince a third person that a man is a malingerer unless that person himself believes it. By the "relocation test" one finds that previously marked areas cannot be relocated with reasonable accuracy. Usually the gait and the attitudes on rising and sitting are normal. One should watch the patient undress, especially when he removes his shoes and hose. Involuntary muscle spasm is not seen in malingerers. Actual traumatic areas usually are diffuse, with widely spaced normal areas. Exaggeration, which means magnification of a real condition, always creates a difficult situation.

Hysteria reveals a disproportion between the subjective symptoms and the clinical observations. Other stigmas of neurosis are usually observed. There is more pain but less rigidity, except voluntary muscle spasm. Normal roentgenograms assist in making a diagnosis.

Infectious Disorders. Tuberculosis. Differential diagnosis between tuberculosis and arthritis may be difficult. Tuberculosis shows little tendency toward regeneration of bone, a striking feature in cases of arthritis. Tuberculosis causes rigidity from voluntary muscular spasm, pain, and bone destruction.

Pyogenic osteomyelitis of the knee is indicated by a history of a preceding infection, the acute febrile state and the early destruction of bone. Lesions of the bones which also must be borne in mind are those due to syphilis, or other diseases. Syphilis may be ruled out by serologic tests or by response to specific therapy.

Arthritis. Hypertropic or degenerative arthritis is evidence of wear and tear on the knee joint. Typical joint changes, with spur formation, occur, due to untreated or neglected joint disorders. They are nonarticular. Both knees are involved as part of a generalized osteoarthritis, which manifests itself in one or both joints due to increase in weight, postural defects, or other situations which result in abnormal mechanics or overuse. An advanced degree of arthritis may be present for years and not manifest itself until one of these precipitants enters the picture.

Arthritis may be recognized from the history, physical findings, and roentgen examination. The disease causes pain, rigidity, and sensitiveness to movement. There is no deformity until the condition is advanced, when the deformity is generally of the valgus type. Roentgenograms in lateral projection may show thinning of the cartilage and some narrowing of the joint space with "lipping" of bone at the articular surface and bridging of bone. Anteroposterior views reveal lipping, with spurs.

Synovitis may be due to overuse. This is followed by muscular weakness and a feeling of insecurity. The patient may state that the joint gives way, feels weak, particularly on going downstairs or downhill. There is not very much to be made out on examination, except quadriceps insufficiency and some coarse grating. Forced extension may give rise to pain.

One must consider the differential diag-

nosis of a mild arthritis from an internal derangement and from tuberculosis.

Neoplasms. Benign osteomas, giant cell tumors, and several other tumors occur in the region of the knee.

Osteomas may be multiple. The history shows that the tumor has been present for a long time and that its growth is slow. There is often no pain unless the osteoma interferes with other structures. The roentgenograms show that the structure of the tumor resembles that of normal bone.

Malignant new growths are not frequently seen in and about the knee. They cause persistent pain that is not relieved by recumbency. Rigidity from involuntary muscle spasm is present. Deformity does not occur until there has been considerable destruction of bone.

Carcinoma. In cases of carcinoma, there is usually a history of a primary focus in a breast, prostate, thyroid, kidney, adrenal gland or gastrointestinal tract. The roentgenograms will show absorption of the bone calcium and obliteration of the detail structure of the bone, suggesting that it is being gradually dissolved. As a rule, there is no evidence of new bone formation.

Sarcoma usually produces a large swelling which develops rapidly. In some cases, the bone is eroded, but the erosion is not confined to the same parts of the bone, as is commonly the situation in tuberculosis. The osteoplastic type of sarcoma shows an increase in the density of the involved bones. The diagnosis is made on the basis of roentgenograms which disclose the characteristic bone changes of this disease in certain other locations of the body, i.e., irregular hypertrophy and rarefaction with linear striations.

Nutritional and Metabolic Disorders. Rickets occurs during dentition. It should be easily differentiated from tuberculosis, which is rare before the age of 2 years. Rickets may cause pain. It usually produces knock-knees or bowlegs. When the tibia is curved, the thickening of the cortex is on the concave side, whereas in syphilis it is on the convex side. Other evidences of rickets include the "rachitic rosary," square head, irregular and broad epiphyses, "potbelly," Harrison's groove, coxa vara and altered calcium and phosphorus levels in the blood.

Osteomalacia. In the osteomalacias, especially the hunger type, which was frequently observed in Germany shortly after World War I, there is softening of the bones of the knee with bending.

In *acute cases,* roentgenograms usually show only capsular distention, with a floating patella. Narrowing of the joint space on the side of the deranged cartilage as seen in the anteroposterior exposure has not been a common finding. Sprain of the internal collateral ligament of the knee is to be differentiated by location of the maximum pain and tenderness about 1 inch above the level of the cartilage over the medial condyle of the femur. The lateral meniscus derangement is diagnosed with difficulty. Tenderness over the cartilage is usually misleading.

Miscellaneous Conditions. The following conditions may cause similar symptoms: loose body; quadriceps insufficiency; enlarged or injured retropatellar fat pad; ruptured lateral ligament; injury to the anterior crucial ligament; adhesions; slipping tendon; joint disease (arthritis); intraarticular fracture; fractured patella, and recurrent dislocation of the patella.

Quadriceps Insufficiency. The weak wobbly knee which gives way, which is the subject of recurrent attacks of synovitis, which is weak and untrustworthy—such weakness being particularly noticeable on going downstairs—is often ascribed to a damaged cartilage. Without a definite history of locking, and locking which requires manipulative interference, the diagnosis of a meniscus disorder should not be made when the quadriceps is wasted and lacking in tone. Such a patient should be treated for muscle insufficiency. If there be a recurrence of the symptoms, with the muscles in good condition, internal derangement is suspected.

THE MENISCI

The menisci are compressible to normal mechanics, but fragile and friable to abnormal mechanical forces. Menisci crack like glass. I have cracked them often experimentally during operations, where I could clearly observe the phenomenon.

According to Palmer, the menisci, while retaining their resiliency, may be compressed from 5 to 2½ mm. in thickness.

Functions Attributed to Menisci by Various Writers. (1) Deepen "joint socket." (2) Improve the "fit" of bones compensating for incongruity of ends of bones. (3) Movable wedges. (4) Mobile lips of joint. (5) Shock absorbers. (6) Compressible wedges. (7) Ball bearings to facilitate rotatory movements. (8) "Brake shoes" against abnormal excursion of bones. (9) "Wagon chock" preventing undue forward gliding. (10) Equalizers of intraarticular pressure. (11) Cushions to minimize concussion of joint. (12) Stimulators of lubrication of joint by their movement. (13) Improvers of resiliency of joint. (14) Increase gracefulness of gait. (15) Springs that store energy for release when pressure is removed. (16) Increase elasticity of gait by resilient rebound. (17) Protectors of peripheral joint structures by their sliding action. (18) Protectors of the hyaline cartilage of joint surfaces. (19) Prevent friction in joint. (20) Defenders against arthritis.

Meniscus disturbances include posterior horn lesions; lateral meniscus lesions; cysts of lateral meniscus; discoid meniscus; dual lesions; calcification of meniscus; ossification of meniscus; hypermobility of meniscus; tumors of menisci; Smith-King syndrome.

History. A clear and accurate history is essential. It is equal in importance to any part of the physical examination. It is often more important than the x-rays. The question of previous accidents to the knee must be carefully noted. The exact sequence of events when the accident happened should be obtained: Did something in the knee give way and so cause the patient to fall? Or did some external force or slip cause the fall? If the former, an internal derangement is most likely. The question of locking, the degree of swelling and the rapidity of its onset are important points.

Symptoms. The usual history of symptoms is as follows: The patient sustains a sudden twist of the knee associated with pain in the joint. It may cause him to fall to the ground. On arising he finds he is unable to extend the joint completely and attempts to move the joint cause pain. In a typical case, the "locking" persists until the cartilage is reduced by manipulation or surgery. Effusion into the joint usually appears within a few hours. The pain is situated over the anterior end of the meniscus and frequently also over the medial border of the tibia. In posterior horn injuries, the pain is more marked on the posterior aspect of the joint.

Diagnosis. The first point in diagnosis is to determine if a meniscus lesion is present. If positive, the second consideration is a decision on which cartilage is affected. The differential diagnosis between a rotation strain of the knee and a cartilage injury may be very difficult in certain cases. When Bristow could differentiate between strain and cartilage injury, he advised gymnastics. If it were strain, gymnastics would cure it; if a cartilage injury, it would aggravate the symptoms.

The point of tenderness of the primary injury and early recurrence is of great importance in the differentiation between lateral and medial semilunar cartilages. It is impossible in some cases to make a positive diagnosis, and exploratory arthrotomy is necessary.

In many cases, an excellent tentative diagnosis can be made from the history alone.

Frequency of Meniscal Injuries:

1. Fracture-dislocation.
2. Dislocation without fracture.
3. Fracture without dislocation.
4. Erosions—irregularities of the cartilage surface usually encountered in the later stages of the knee joint osteoarthritis.

The tibial collateral ligament has been regarded as a key structure viewed from the standpoint of function. Its intimate relationship and connection with the medial meniscus is generally accepted as the reason why this meniscus is damaged so much more frequently than the lateral.

In expert hands the diagnosis of true hypermobility of the cartilage is permissible.

Examination. It is wise to follow some routine, or important points may be overlooked.

The *Lewin test* for internal derangement of the knee: While standing, the patient is instructed to perform the test on the unaf-

fected leg first. He is told to maintain his heel and toes on the floor and then to flex and extend his knee forcibly. This should be carried out perfectly on the unaffected side. He is then asked to repeat the same movements with the affected leg when it will be seen that the extension is incomplete and the knee springs back to the flexion position. This movement may or may not be accompanied by pain. This should be done actively and passively.

The *McMurray test* is of great value in those injuries to the cartilage where the lesion involves the meniscus at, or behind, the middle of the joint. When the test is correctly applied, not only can the presence of a lesion be determined but its site can be mapped out with comparative certainty.

In making the examination the patient must be recumbent and relaxed; the surgeon standing on the side of the injured limb grasps the foot firmly, while the knee is flexed, until the heel approaches or touches the buttock. The foot is now rotated externally, and the leg abducted at the knee. Holding the leg and foot at this angle, the knee is slowly extended. With the alteration of the angle of the joint any loose portion of the medial meniscus is caught between the articular surface of the femur and tibia, and the sliding of the femur over the abnormal portion of the meniscus is accompanied by an appreciable click and pain.

The examination should be completed by a similar extension of the knee from full flexion, while the foot is rotated inwards and the leg abducted. If a click is produced it is possible to determine, from its severity and the angle of the joint at the time of its occurrence, the size of the broken portion of the meniscus and its location.

If the patient is particularly nervous, I employ intravenous pentothal sodium anesthesia. My experience with the McMurray maneuver has been very favorable diagnostically and therapeutically.

Treatment. Conservative measures, as a rule, are of only temporary value if the derangement continues to recur. Rarely, symptoms may eventually be relieved if the defect in the meniscus heals or the displaced fragment is absorbed; on the other hand, the joint may be irreparably damaged if surgical removal is delayed.

If the medical profession could be taught to place under proper surgical care patients with internal derangements of the knee, before they develop relaxation of the muscles, it would be a great step forward.

Treatment consists in immediate reduction of the displacement, if possible by manipulation followed by the application of a retentive bandage or a plaster cast. As a rule, weight bearing with the aid of crutches, with the knee in the extended position, is not harmful. If repeated dislocations occur, the indications are to remove the meniscus. This can be done by a simple operation, although technic and asepsis must be perfect because of the danger that an infection may occur and a stiff knee result. Some writers advocate removal only of the injured portion of the meniscus.

Operative Treatment for Meniscus Lesions. Local anesthesia is preferable to spinal or general anesthesia. A thorough study of the patient should be carried out before the operation. Complete hemostasis should be obtained. No knee joint should be closed without a visual inspection of the patellofemoral articulating surfaces to determine the presence or absence of chondromalacia.

Bristow advised a simple incision, avoiding the patellar branch of the saphenous nerve. The synovial membrane is opened above the medial cartilage and the joint inspected. If the cartilage is torn and the central portion displaced, the displaced part and the peripheral portion are removed as far back as convenient. If the joint appears normal, the anterior portion is freed and pulled forward to determine whether the posterior portion is torn. This procedure is important as it would be difficult to recognize a posterior tear otherwise. If the posterior half is normal, the detached anterior portion is removed and the posterior part left. The next step is exploration of the lateral portion to determine whether the lesion is a tear of the lateral meniscus.

A tourniquet is of great advantage. A pneumatic tourniquet is advised where the amount of constriction can be accurately determined. West maintains that the meniscus must be removed whether the split can be

seen or not, and that localized tears or detachments of the posterior horn cannot be seen until removal of the cartilage is almost complete. "Large compression dressings of either absorbent cotton or sheet wadding are applied with resilient bandages as reinforcement, extending from the ankle to the groin. The tourniquet may be removed upon closure of the synovial membrane in order to obtain complete hemostasis."

In the *Campbell* technic the skin and superficial fascia are incised, beginning 1 inch medial to the middle of the patella and passing downward and parallel with the lower half of the patella and patellar tendon a distance of 2 inches, thence curving posteriorly for 1 or 2 inches. That there may be less danger of communication with the skin of the knee joint after closure, an incision is then made through the deep fascia and capsule ½ inch medial to the skin incision. At the proximal end of the wound the synovial membrane is grasped by two small hemostats, one of which is held by the operator and the other by an assistant; while traction is maintained on these instruments, a small opening is made into the joint with a scalpel. If there is irritation within the joint, fluid will escape immediately. The openings in the capsule and synovial membrane are enlarged with scissors to the size of the skin incision and all excess fluid is gently sponged from the joint. The medial cartilage is examined to determine the nature of the defect.

Cave and Bosworth each described a double capsule incision with a single skin incision.

The first step consists of an oblique incision slanting upward and slightly backward over the anterolateral or anteromedial aspects of the joint, depending upon which meniscus is to be removed. Such an incision will avoid injury to the patellar branch of the saphenous nerve since it parallels the course of this nerve. The skin and subcutaneous tissue can be drawn forward and the capsule opened at the usual point anteriorly, in line with its fibers, by a vertical incision. The synovium above the meniscus should be opened between two pairs of forceps, care being taken not to mark or to cut the articular surface of the underlying femoral condyle. The small synovial pouch below the meniscus, between it and the tibia, should be opened in similar fashion. By means of curved scissors, one blade of which is placed above and the other below the meniscus, the anterior end of the meniscus can be freed from the synovium and the coronary ligament. In like manner, the base of the meniscus can be dissected free from its attachment to the collateral ligament. The knee is then flexed and the skin and subcutaneous tissue are dissected backward from the collateral ligament close to the capsule of the joint. The capsule is opened over the posterolateral margin of the femoral condyle behind the collateral ligament by a vertical incision in line with its fibers. The anterior portion of the meniscus is then passed backward under the collateral ligament, and its posterior third can be well visualized extending into the back of the joint. The posterior third is freed from its attachment with scissors as far back as the posterior tibial spine. If a good view of the extreme posterior tip cannot be obtained, it can be divided by a tonsil snare, thus avoiding any danger of laceration of the posterior crucial ligament.

When the knee is straightened, the posterior incision will be found to close tightly, usually without sutures. The anterior incision is closed with interrupted fine silk sutures, care being taken to draw the subpatellar fat pad out of the joint by including a portion of it in the suture. The skin and subcutaneous tissue are closed with interrupted silk, and a dressing wrung out of Dakin's solution is applied with a pressure bandage. The pressure bandage is cut two hours later and the knee is rebandaged.

Postoperative Management. The snug bandage is left in situ for 24 hours, and is then cut through without disturbing the underlying dressing.

The patient is encouraged to move the leg in bed, and to contract the muscles voluntarily. At the end of 48 hours he should be able to raise the limb from the bed, to tighten and relax the quadriceps on the sixth day or earlier; on the eighth day the sutures are removed.

The patient should be up and walking on the tenth day. His early efforts at walking

are supervised by the masseuse in order to teach him to take an equal length of stride with each foot and to bear his weight symmetrically.

Common Causes of Operation Failure. Incorrect diagnosis; incomplete diagnosis; wrong structure operated upon; pathologic changes in structures not visualized at operation; pathologic changes not recognized at operation; incorrect "timing" of operation; incorrect postoperative care; postoperative complications (infection, thrombophlebitis, thrombosis, psychoneurosis); psychoneurosis; compensation factors.

In manipulation: don't add insult to injury; "easy does it"; use an anesthetic; don't brutalize an injured knee.

Prognosis. The prognosis of meniscal injuries is very favorable. The results following meniscectomy are among the best in the whole field of bone and joint surgery, although persistent pain, effusion or limitation of movement are occasionally encountered.

The best results are obtained in young adults when the offending meniscus is removed within a short time after the injury is sustained.

FAT PAD

Hoffa's Lesion: Lipoma Arborescens. In 1903 Hoffa studied a case of striking hypertrophy of the adipose tissue located beneath the patellar ligament. In 1904 he reported 7 similar cases, in each of which an operation was performed. The syndrome, however, was described by Annandale in 1887 and Allingham in 1889.

Fatty bodies may develop in the synovial fringes, producing lipoma arborescens.

Diamant-Berger and Sicard reported 3 cases, in the first of which there were two distinct lesions: a benign prepatellar hygroma which was present before the trauma; and hyperplasia of the infrapatellar fat pad which was related to the trauma and caused pain. The second was a case of volvulus of the pedicle of an intraarticular lipoma of the knee, and third, a case of an arborescent lipoma which developed in the course of a post-traumatic chronic arthritis and was treated by synovectomy. They believe that the condition can be explained on the basis of post-traumatic hyperemia.

They divide the cases into those localized in the infrapatellar fat pad as Hoffa's disease, or in a synovial fringe called a solitary lipoma or form a generalized arborescent lipoma. Hoffa's lesion may be a sequel of traumatic arthritis of the knee. The arborescent lipomas have been thought to be of spontaneous origin; tuberculosis has been found in some.

It is probably caused by trauma producing hemorrhage into the plicae alares and a gradual transformation into chronic hyperplasia of the synovial membrane. Hydrops is superimposed and ultimately pain develops from pinching of tissues.

Contusions of the Fat Pad. Contusion or bruising of this structure is a definite traumatic entity and is caused usually by a direct blow on this area of the joint. At other times it is a complication of ligamentous injuries. The diagnosis is made by the swelling and tenderness just below the patella and to either side of its tendon. There is usually a feeling of fullness at this site and pain on full extension of the knee but there is no definite locking or blocking of the joint as seen in the cartilage and tibial spine cases. At times the symptoms do not come on immediately following the trauma but gradually increase for twenty-four or forty-eight hours. In the most acute cases aspiration, if effusion is present, and rest in a plaster cast with the knee flexed to about 20 degrees for at least two weeks is indicated. This should be followed by a compression bandage and an elevation of the heel of the shoe on the affected side for an additional two or three weeks. In the milder cases, the latter part of this treatment is all that is needed.

Diagnosis. In Hoffa's disease, according to Mercer, the pad is usually enlarged, and the swellings on either side of the ligamentum patellae are tender. This tenderness persists or is more pronounced when the joint is fully extended. This is a characteristic sign. The quadriceps may show a degree of atrophy.

When the knee joint is extended, the patella is drawn up by the contracting quadriceps, and the infrapatellar pad of fat is similarly pulled up to avoid being caught between the

tibia and the femur. But when an excess of fat has been deposited in the pad, or when the quadriceps loses its tone, it may not be sufficiently drawn up, and is then liable to be nipped between the opposing articular surfaces. Repeated trauma of this nature is associated with hemorrhage into the pad, and further thickening; it becomes hard, and may project beyond the margins of the patellar ligament in the form of two small swellings each about the size of a walnut. This form of enlargement is most common in young athletes.

In older subjects, the infrapatellar pad may be hypertrophied or associated with intraarticular arthritic changes, as. for example, villous hypertrophy of the synovial membrane.

The symptoms are those of chronic intractable, recurrent hydrarthrosis.

The knee is painful, and the pain is situated just behind the infrapatellar ligament. Motion is restricted and the patient may complain that the knee is weak and liable to recurrent attacks of swelling. These complaints are more marked after exercise or following prolonged use.

True locking does not occur, but at intervals the joint may appear to "give way" or a sharp stabbing pain may occur which temporarily limits the patient's physical activity.

Progressive limitation of extension results from interposition of the hypertrophied fat pad between the articular surfaces. This makes the patient walk with his knee partially flexed, bearing his weight on the metatarsophalangeal joints with the foot in the equinus position.

Examination reveals hypertrophy of the fatty ligament producing a painful swelling on both sides of the patellar tendon, which may be exaggerated when the patient stands; absence of bony changes around the joint; painful limitation of extension with normal flexion; atrophy of the quadriceps; and sometimes the presence of a roentgen shadow.

Radiologic examination is usually negative; occasionally, however, calcium salts are deposited in the hypertrophied fat and may cause a shadow in the location of the pad.

Treatment. Jones recommends the simple but effective device of raising the heel of the shoe on the affected side; this prevents full extension, and may be followed by subsidence of the swelling and disappearance of the symptoms. In severer cases, further measures may be required; in this connection, a hinged knee cage, so arranged that extension is arrested some 20 to 30 degrees short of full extension, may prove of service.

Conservative measures should always be supplemented by exercises, massage, and faradism, to strengthen the wasted quadriceps.

If conservative methods prove ineffective, the pad should be removed.

An incision is made to the medial side of the lower part of the patella; the pad is exposed and removed by a pair of curved scissors. In many cases more adequate exposure is needed.

The joint is approached through a longitudinal incision on the anteromedial aspect of the knee. A careful search is made for other derangements of the joint. If none are found, attention is given to the villi or fat pads. If symptoms have only recently appeared, there should be evidence of hemorrhage or marked congestion of the affected villi or pads; otherwise, there should be more or less fibrosis from subsequent injuries. The enlarged mass is caught by rat-tooth forceps and excised with curved scissors as near its base as possible. One or two blood vessels must be tied. The defect, if large, is covered by synovial membrane.

A posterior gutter splint is applied and is worn for a few days. Walking is permitted on the tenth day.

Surgical Repair of Fresh Posterior Lipping Fractures of the Tibia*

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IN recent years, both in private practice and on the Fracture Service at Cook County Hospital, posterior lipping fractures of the tibia involving a posterior dislocation of the astragalus with an upward and posterior displacement of the posterior lip of the tibia have been seen with increasing frequency. Until 1942 the senior author had attempted to repair this type of fracture by various methods of double pin fixation using the Boehler apparatus and innumerable technics of plaster cast application. The follow-up of cases treated by this method revealed a very high incidence of traumatic arthritis with destruction of the cartilaginous surfaces of the astragalus and tibia and subsequent painful weight-bearing joints that later required an ankle fusion.

Observing the unhappy end results of the treatment formerly employed led one of the authors, in 1942, to begin the internal fixation and accurate reapposition of all of these types of fractures, as soon as the diagnosis was made.

Only by early recognition of the pathology and early operative intervention was it possible to secure an accurate reapposition of these fractures. With the proper equipment an experienced operator is able to obtain an anatomic hair-line reduction of the posterior lipping fracture, so that on the x-ray film it is impossible to detect any irregularity of the weight-bearing surface of the tibia.

It is not the purpose of this paper to discuss the treatment of old posterior lipping fractures with osteoarthritic changes, as it is a well recognized fact that the only solution to this problem is an ankle arthrodesis. We are interested only in discussing the treatment of fresh posterior lipping fracture.

ETIOLOGY

Fractures of the posterior lip of the tibia rarely occur without an associated fracture of the internal and external malleoli. For this reason this type of fracture has been called trimalleolar fracture. Cotton of Boston was probably one of the first men to call our attention to this particular type of fracture and therefore many men recognized this fracture by the name of the "Cotton Fracture".

Occasionally one sees an isolated fracture of the posterior lip of the tibia without fractures of the internal or external malleoli, but this is indeed a rarity. This is possible only when there is an associated tearing of all the ligaments about the external or internal malleoli, as well as those of the tibioastragaloid articulation. When these conditions are present they permit the ankle to dislocate posteriorly and carry off the posterior lip of the tibia.

In order to produce this fracture it is necessary that violence be thrown on the long axis of the leg with the foot in the equinus position. A very common cause of this type of injury is to trip while going down the stairs, catching the heel and throwing the person forward, thus producing a trimalleolar fracture. In view of the fact that it is the present vogue for women to wear high heels, this type of fracture occurs far more frequently in women than in men. It is practically impossible to produce a posterior lipping fracture with the foot and ankle in the flexed position. Usually, when violence occurs to the ankle with the foot in this position, an anterior lipping fracture or a vertical compression fracture of the tibia is produced. It is not the purpose of this paper to discuss this rather uncommon type of ankle fracture.

Posterior marginal fractures of the tibia are sustained in one of the two following ways:

1. They may be the result of external rotational injury of the ankle joint in which a torsional strain produces a spiral fracture of the external malleolus, the fracture running

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upward and outward from the tibiofibular joint. When the force continues, the fracture of the fibular malleolus is associated with an avulsion fracture of the tibial malleolus or a rupture of the internal ligament with an outward dislocation of the foot. With the force continuing and the foot in the equinus position there is produced a posterior marginal fracture of the tibia with a posterior dislocation of the astragalus and the fractured segment of the tibia (Fig. 1, 1, 2, 3).

2. The same type of fracture may be produced by an adduction injury to the foot and ankle where the foot is forcefully inverted and the astragalus has been driven inward and upward against the mortice of the articular surface of the tibia and fractures the internal malleolus at its base. As the force

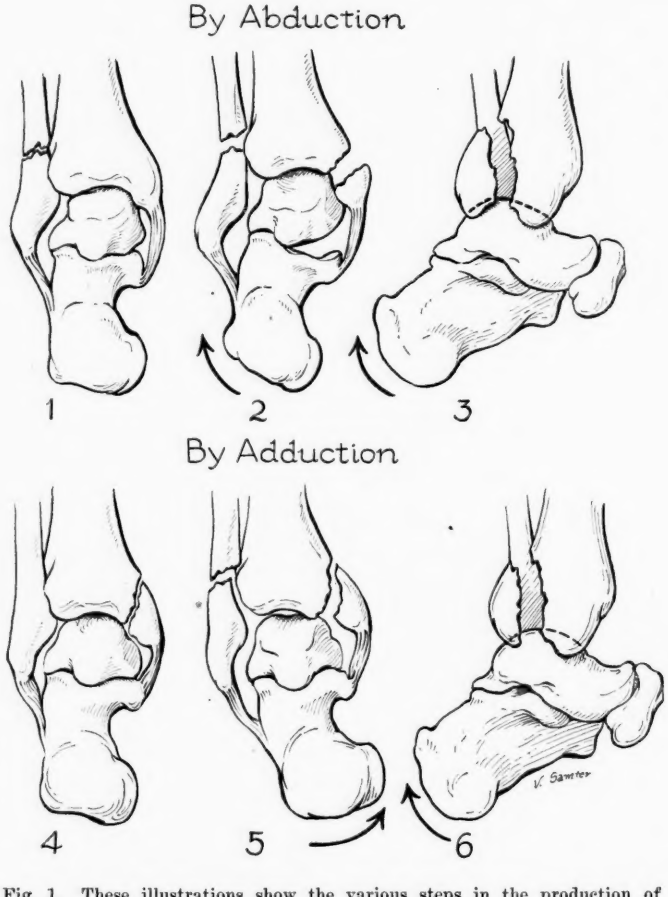

Fig. 1. These illustrations show the various steps in the production of posterior lipping fracture by the mechanism of abduction and adduction. 1, Fracturing of the external malleolus by abduction; 2, avulsion fracture of internal malleolus; 3, posterior dislocation of the astragalus taking place as the result of the fracturing and separation of the posterior lip of the tibia; 4, fracturing of the internal by adduction; 5, fracturing of the external malleolus by the continuation of the force into adduction; 6, final stage in the pathology, the fractured posterior lip of the tibia with posterior dislocation of the astragalus.

continues the lateral malleolus is avulsed at or near its tip and as it continues, the posterior marginal fracture of the tibia occurs, with backward dislocation of the astragalus on the foot (Fig. 1, 4, 5, 6).

As previously stated, only in very rare cases is it possible to obtain a pure posterior dislocation of the foot with a fracture of the posterior lip of the tibia but without associated fractures of both the internal and external malleoli. This is possible only when the violence has no opportunity of adduction or abduction of the foot, but is a pure posterior violence usually produced when the foot is held in a fixed position and the body weight is thrown forward with a great deal of violence, so that the only active force involved is forward displacement of the tibia.

PATHOLOGY

The pathology of fractures of the external and internal malleoli is well known by everyone who has had any experience in traumatology. The internal malleolus is notorious for its high incidence of nonunion owing to the fact that all too frequently a flap of periosteum drops between the fragments and union is prevented because of soft tissue interposition. In our experience the incidence of nonunion from simple fracture of the internal malleolus has been approximating 35 per cent.

Fractures of the external malleolus present no real problem and we have never seen nonunion in this region. Apparently, vascularity of the bones and the fact that reapposition is so easily obtained accounts for the high incidence of union. Neither capsular nor periosteal interposition has ever been observed by us in this type of fracture.

It is somewhat difficult to see the pathology of posterior lipping fracture per se unless one has had the opportunity of operating on a considerable number of these cases and observing them from the posterior approach. By no form of anterior, medial, or lateral incision is it possible to see the actual pathology and to be able to replace the fragments to their normal position. The posterior approach is the only method in which clear vision can be obtained. Occasionally, small fragments of bone break off and prevent the accurate reapposition of the posterior lip of the tibia to the main fragment. In such instances the fragments must be removed. We have never observed soft tissue interposition in this area. Hematoma formation occurs quite quickly and the resulting fibrous tissue becomes quite solidified in a relatively short period of time, so that unless the case is operated on within the first week or 10 days accurate reapposition of this fragment becomes practically impossible. In addition, the contractures of the soft tissues, especially the Achilles tendon makes the accurate reduction of the posterior dislocation of the foot quite difficult. For this additional reason it is also important that reduction be obtained early before soft tissue contractures occur.

SYMPTOMS AND SIGNS

The appearance of the foot and ankle following a posterior lipping fracture is very characteristic. The diagnosis can be made very accurately without x-ray films if one bears in mind these important points:

1. There is an increased arching of the normal curvature of the Achilles tendon as it runs into the os calcis. It becomes almost semicircular in its configuration.

2. There is a definite visible protrusion of bone at the ankle, this being the anterior surface of the tibia which now finds itself subcutaneous and about one inch anterior to the weight-bearing portion of the astragalus that formerly was in a juxtaposition with the tibia.

3. In addition, there is a widening of the ankle joint in all cases, due to a combination of edema, hemorrhage, and displacement of the internal and external malleoli. After 48 to 72 hours there is an associated ecchymosis of the surrounding area frequently extending to the upper portion of the calf, with associated edema. The points of exquisite tenderness in a trimalleolar fracture are primarily over the external and internal malleoli. Due to the displacement of the posterior lip and lack of bone contact with the main fragment of the tibia pressure in the mediolateral aspect of the Achilles tendon is not usually associated with much discomfort to the patient.

If the patient is cooperative and willing to tolerate some additional pain it is surpris-

ing to notice that the patient is able to extend the foot quite well, but has a complete loss of flexion. This is due to the mechanical disadvantage at which the ankle finds itself once a posterior dislocation has occurred.

DIAGNOSIS

The diagnosis of a posterior lipping fracture can be made quite accurately from the history and physical findings. An individual who trips while going downstairs, stepping off a curb, or alighting from a bus with the ankle in the equinus position followed by a fall and associated with severe pain and discomfort of the ankle is a candidate for a posterior lipping fracture of the tibia. Immediately after the fall there is a resulting deformity of the foot and ankle with the three prominent factors, as mentioned above under symptoms and signs, that aid in the diagnosis and can be considered almost pathognomonic for posterior lipping fractures of the tibia. Needless to say, x-ray films are always used for confirmation and to determine the extent of the fractures.

PROGNOSIS

The ultimate outcome of this type of fracture naturally depends on the severity of the injury and the accuracy with which the reduction has been performed.

The accurate surgical reduction of this fracture decreases the complications almost to the disappearing point. Posttraumatic arthritis of the tibioastragaloid joint does not occur if the reduction has been done accurately. The limitation of motion of the foot and ankle is minimal if the internal fixation has been well placed and early active motion of the foot and ankle is performed. It has been our experience that no weight bearing should be permitted on this type of fracture under 4 to 4½ months from the date of the operative intervention, otherwise there is grave danger of displacing the posterior fragment and getting a recurrence of the posterior dislocation of the astragalus. Obviously, either one of these complications constitutes a complete failure.

In cases that have been seen late or that have not been accurately reduced the incidence of joint changes with progressive osteoarthritis and a painful weight bearing joint occurs in all cases of this type. The best solution to this problem is an arthrodesis of the ankle. Anyone of the numerous types of arthrodesis is satisfactory, depending, of course, on the experience of the surgeon and the pathology that is present at the time the operation is being performed.

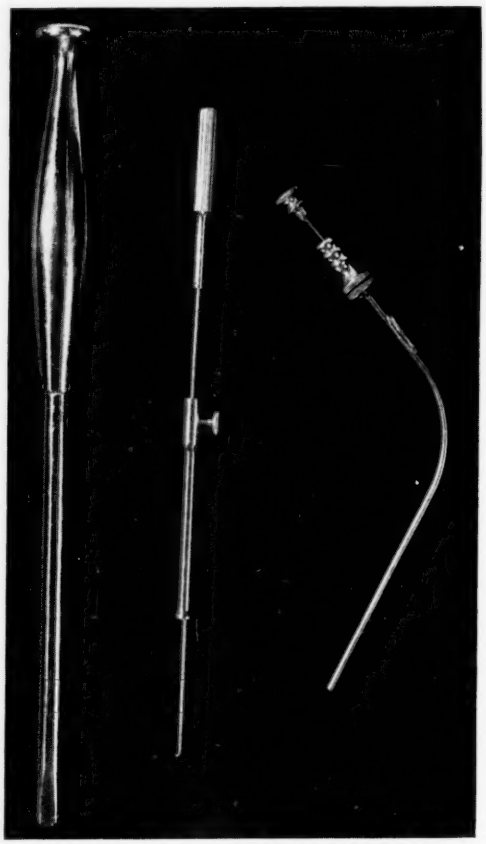

Fig. 2. From left to right Schrey pressure bar—Jackson depth gauge—Frazier aspirator. These three instruments greatly facilitate the surgical repair of this type of fracture.

TREATMENT

As stated previously, it is our firm conviction that posterior lipping fractures should

be operated on as soon as the diagnosis is made and the patient's general physical condition permits. Only by early intervention is one able to reappose accurately the fragments, see the dentations of the fragments so that they can be fitted anatomically, and prevent the soft tissue contractures and the spasm of the gastrocnemius with posterior upward displacement of the astragalus.

Over the last six years it has been our observation that at operation there are three fundamental requisites necessary in order to deal with this fracture with some degree of finesse:

First and foremost is the position on the operating table. The patient must be placed in a prone position with the feet just over the end of the operating table, so that the foot can be pushed anteriorly and acutely flexed without any interference, so that at the time of the operation it may be brought to a right angle with the leg.

Next, and of no less importance, is the unobstructed field of vision. This is obtained by an adequate incision and the avoidance of continuous oozing in this richly vascular field by the use of a Martin constrictor. It might be well to interject at this point that a poorly applied constrictor is worse than no constrictor at all. To attempt operation on posterior lipping fractures without a constrictor is like trying to find a golf ball at

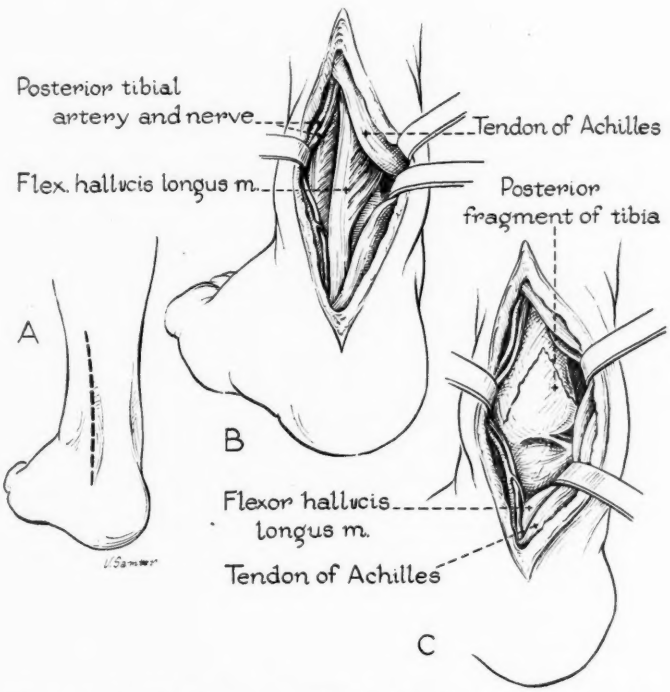

Fig. 3. A, Line of incision just medial to the medial border of the tendon of Achilles. B, The tendon of Achilles is retracted laterally and the posterior tibial artery and nerve are retracted medially, exposing the tendon and part of the muscle belly of the flexor hallucis longus muscle. C, With the flexor hallucis longus muscle and tendon retracted laterally, the fracture of the posterior lip of the tibia can be easily seen.

the bottom of a muddy creek. Complete visibility is essential. Complete dryness in the field can be obtained by the use of a neurosurgical aspirator, either of the Frazier or Adson type, thus obviating the necessity of frequent and time-consuming sponging with coarse gauze dressings on instruments (Fig. 2).

Instruments, too, are important and deserve some discussion. We have run the gamut of periosteal elevator, screw drivers, and more blunt instruments of various kinds for holding the marginal fragment in position while the surgeon drills at least two holes and fixes it with two screws. This perhaps is the most critical stage of the operation and on which

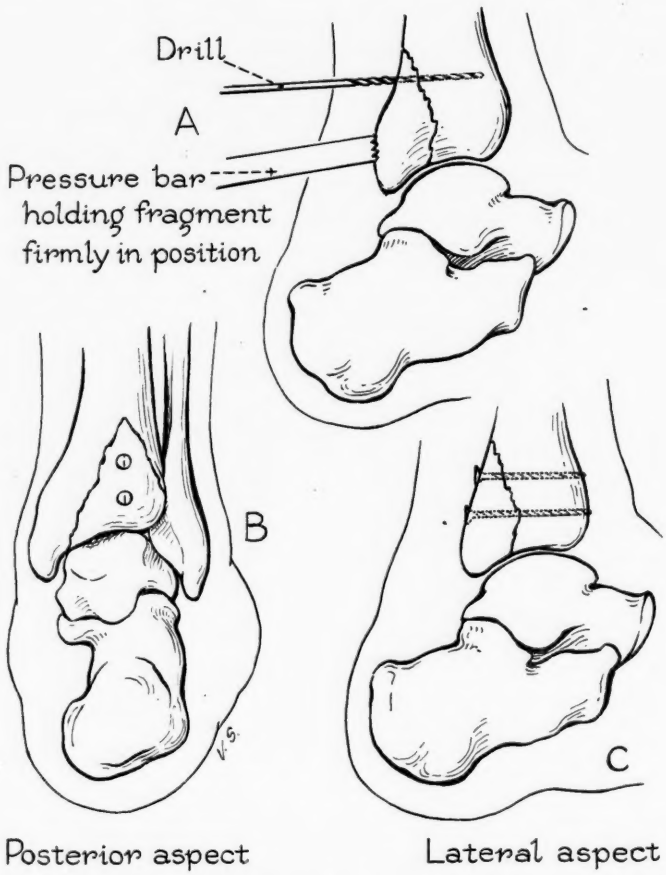

Fig. 4. A, Reduction of the fracture is accurately performed and the posterior lipping fragment is held in place by the pressure bar. The serrated end is broad enough so that further fracture of the thin shell of bone does not occur, while the surgeon drills the hole for the insertion of the first screw. B, Schematic illustration showing fixation of the fragment with two screws. This prevents rotation of the posterior fragment, and adds to the security of the fixation. C, Lateral view of the ankle mortice showing schematically the desired location of the screws with the tips of the screws just engaging the anterior cortex of the tibia. The use of the depth gauge to select the correct length of the screw is most important.

Fig. 5. M. C., injured Nov. 2, 1947. Preoperative films taken Nov. 4, 1947, after an unsuccessful closed reduction done elsewhere.

a successful outcome depends. If the thinly shelled fragment is further fractured by the surgeon the patient would not be much better off than had he not been operated on in the first place. For this reason, one of us (E. L. S.) has designed a pressure bar (Fig. 2). The bar is 12 inches in length, made of stainless steel, is $\frac{3}{8}$ of an inch in diameter, one end of which is fitted with a handle and the other with fine teeth or serrations. With the aid of the bar the fracture fragments can be gently pressed and held in position without danger of comminution or of the pressure bar skidding off from the fragment (Fig. 3).

With the patient in the prone position an incision is made over the posterior medial aspect of the distal one-fourth of the leg, about $\frac{3}{4}$ of an inch medial to the midline of the Achilles tendon. The incision is carried down to the level of the internal malleolus. The incision carries one through the skin, the superficial fascia, the investing fascia, and finally the flexor retinaculum of the ankle. Care must be exercised when cutting through the investing fascia and flexor retinaculum because on the medial aspect of the incision lies the posterior tibial nerve and artery. These must be carefully isolated and retracted to the medial side. The Achilles tendon is retracted to the lateral side. Immediately anterior to the tendon lies the thick belly of the flexor hallucis longus muscle. This likewise is gently retracted laterally and the posterior aspect of the tibia and fracture come into view. The periosteum must be thoroughly stripped from the posterior aspect of the tibia and sufficient periosteum must be removed from the fractured edge of the posterior lipping fracture so that the small teethlike serrations of the fragments can be fitted accurately into place. At no time is any attempt made to expose the articulations for direct vision. If one can accurately

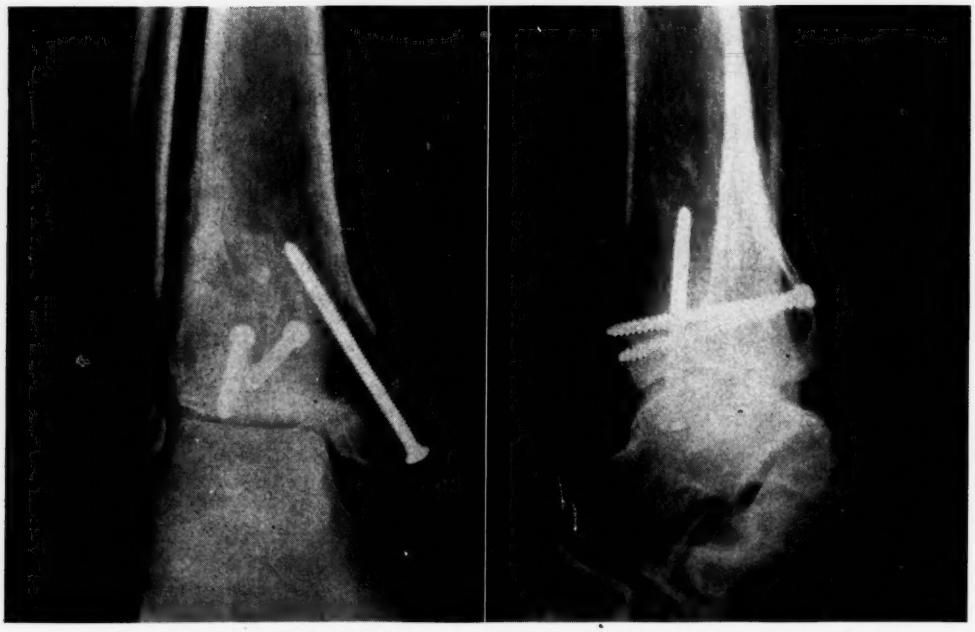

Fig. 6. Same patient as in Figure 5. Films showing end result on May 15, 1948.

see the reapposition of the fragments on the posterior aspect of the tibia and they fit in the anatomic location, the articular surface cannot help but be accurately reduced (Fig. 4). The foot is now gently pushed forward to reduce the posterior dislocation and the marginal fractures manipulated into position. It is here that the pressure bar and the neurosurgical aspirator become of inestimable value. Unless one fits the fragment via its serrations into the serrations of the tibia with great care and accuracy one cannot be sure of an anatomic reduction, and this is the prime object of the operation. When the fragment is pressed home blood is expressed from the jagged fractured edges and obscures vision, but with the aid of the aspirator this troublesome matter is soon under control. The fragment is firmly held in place by the assistant until the surgeon drills at least two holes through the two fragments. It is very important that the hole to the proximal fragment be slightly larger than that in the distal fragment, so that the threads engage only the distal fragment and will permit the drawing together of the posterior lip to the main tibial fragment when the last few turns are applied to the screw. In view of the fact that the hole penetrates the anterior aspect of the tibia, if the screw is at all too long it will interfere with the soft tissues on the anterior aspect. For this reason we have found it most important to use a Jackson depth gauge (Fig. 2) and measure very accurately the length of the screw that must be used. It has been our experience that with the use of the gauge we have never placed a screw too far through the front aspect of the tibia. A screw that does not catch the anterior cortex of the tibia does not have much holding power because the cancellous bone at the lower end of the tibia is very friable.

Two screws are used whenever possible as this prevents the rotation of the fragment and also prevents the possibility of muscle spasm from pulling back on the Achilles tendon, thereby producing a slight subluxation of the astragalus with some diastasis of the posterior lip of the tibia (Figs. 5 and 6).

Before closing the wound it has been our

Fig. 7. M. E., injured July 7, 1947. Preoperative films taken July 7, 1947.

Fig. 8. Same patient as in Figure 7. Films showing end result on Nov. 10, 1947.

Fig. 9. Left, A. P., injured March, 3, 1947. Preoperative films taken March 3, 1947.
Fig. 10. Right, same patient, films showing end result on July 11, 1947.

Fig. 11. V. D., injured Jan. 22, 1948. Preoperative films taken Jan. 22, 1948.

Fig 12. Same patient as in Figure 11. Films showing end result on June 12, 1948.

practice in late years to have a lateral view taken in the operating room to be sure that the screws do not protrude too far through the anterior portion of the tibia and also to be sure that the posterior lip has been accurately reduced with a normal appearing articulation of the tibia. This is the extra safeguard added to the other precautions mentioned above which assure us of accuracy in this procedure. The subcutaneous tissues are closed by a running stitch of 000 chromic catgut and black silk is used for the skin closure. Finally, a cast is applied extending from the middle third of the thigh down to the toes with a slight amount of flexion at the knee and the foot at about right angles to the long axis of the leg. An elastic bandage is applied over the dressings in order to prevent postoperative edema to the structures. The bandage extends from the toes to the middle third of the leg (Figs. 7 and 8).

A change of cast is made at the time the sutures are removed, usually on the twelfth or fourteenth postoperative day, and then a snug-fitting cast is applied, extending from the toes to the middle third of the thigh. At the end of 10 weeks the cast is cut just below the knee so as to permit knee motion, yet the ankle is safeguarded against any activity. Under no circumstances is any weight bearing permitted under four months. Usually at the end of three months the cast is bivalved so that the patient can receive physiotherapy in the form of heat, massage and passive exercises. By the use of competent physiotherapy the patient regains a surprisingly great amount of his original ankle motion (Figs. 9 and 10).

Cases that are not operated on within the first five to seven days become progressively more difficult to reduce and we have had great difficulty in obtaining anatomic reapposition after a period of 14 to 16 days after injury for the reasons mentioned previously.

Cases that are seen late cannot hope to have this form of treatment as it is totally unsuccessful. We believe that the patient who has a great deal of pain and osteoarthritic changes of the ankle should have an ankle fusion performed. We have tried various standard methods with uniformly good success (Figs. 11 and 12).

CONCLUSIONS

Twenty-three cases of this type of fracture have been operated on by the authors in the last six years with uniformly good success.

Early operation, accurate reduction, and firm internal fixation by the use of two screws are essential. Before closing the surgical wound it is advisable to have a lateral x-ray taken to be sure that the screws do not protrude beyond the anterior cortex of the tibia and that the joint surface of the tibia has been anatomically reapposed. Unless this is done the operation cannot be classed as successful.

It has been the experience of the authors that it is necessary to use a constrictor, a surgical aspirator, a pressure bar, and a Jackson depth gauge in order to perform accurately internal fixation under direct vision. Without clear vision the most skilled surgeon would be working under a terrific handicap in this type of procedure.

Spina Bifida and Cranium Bifidum*

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SPINA bifida is the most common congenital defect of neurosurgical importance in infants. Ingraham and his associates [6] reported its occurrence in one of 4,150 new admissions to the Children's Hospital in Boston over a period of 20 years. This defect may occur at any level of the spinal column, but is most frequent in the lumbosacral region. This can readily be appreciated when it is recalled that the invagination and closure of the neural tube proceeds caudally from the rostral end of the embryo. The severity of the defect ranges from so-called spina bifida occulta with perhaps only a failure of fusion of one or more vertebral laminae, to severe dysplasia of the spinal cord with extensive defects in the vertebral laminae and overlying soft parts.

The generally accepted classification of spina bifida is not entirely satisfactory as it is based on the conception of the possible protrusion of normal spinal cord or nerve roots into a sac composed of skin, dura, and pia arachnoid. On the contrary, in a myelocele, the most severe type of defect, there is a failure of the neural ectoderm to invaginate into a neural tube and as a consequence it is exposed on the dorsal surface of the body. It may be covered by parchmentlike epithelium, or may be exposed as an area of reddish granulation tissue with cerebrospinal fluid oozing from a pore in its center. The defect includes not only skin, subcutaneous tissue, deep fascia, muscles, and vertebral elements, but also meninges. The latter, however, are formed beneath this flattened-out plate of neural ectoderm from the ventral surface of which both the anterior and posterior roots of the spinal nerves arise. The dura is fused laterally to the lumbar fascia; the pia arachnoid makes a lining for the cavity beneath the rudimentary cord. Various gradations of malformation of the spinal cord may be seen from the primitive plate of neural ectoderm to a rudimentary groove or even partially closed tube. On occasion, in the epithelized types, the central canal of the rudimentary spinal cord may be dilated to form an intramedullary or syringomyelic cyst.

Meningoceles are less common. Here the defect is in bone and soft tissues with protrusion of the meninges to form a sac of variable size distended with fluid. Sometimes the neck of the sac may be very small, and on occasion may have spontaneously closed, so that an isolated cyst is left above the level of the deep fascia. The meningocele usually is covered with normal skin and subcutaneous tissue although the latter may be thin or largely lacking.

It may be stated that where the spina bifida is covered with normal appearing skin, myelocele is seldom found; conversely, where the skin is abnormal or reduced to mere epithelium, myelocele usually will be found.

The dura and arachnoid may be separated or fused and the sac may be multilocular. When the sac is open, unless the pedicle is too narrow, the normal spinal cord or nerve roots can be seen lying in the spinal canal.

A third form of spina bifida is that in which there is a defect in bone and deep soft tissues with an overlying lipoma of varying size covered with normal skin. This lipoma may have a small fibrous stalk of attachment to the normal dura as its only communication with the spinal canal, or the lipoma itself may extend into the spinal canal through a larger defect in the bone and sacrospinalis muscles and fill the extradural space for several segments. On one occasion, a large lipoma was attached to a small myelocele which was not recognized preoperatively.

Finally, we have spina bifida occulta with no external evidence of a bony defect, but with roentgenographic evidence of failure of fusion of the vertebral laminae. Ingraham and Lowrey [6] have stated that 25 per cent of normal children have spina bifida occulta. This of course persists in many adults. Some of these cases have pigmentation or hypertrichosis of the overlying skin.

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Various associated anomalies and deformities may be associated with spina bifida. Harelip, cleft palate, ectopia of the bladder, syndactylism, nonparalytic clubfoot, congenital dislocation of the hip and so on, may be present. In the more severe forms of spina bifida, the lower extremities may develop trophic ulcerations; paralytic forms of clubfoot may be present and the constant dribbling of urine may lead to excoriation of the external genitalia. The growth of the lower extremities lags behind the rest of the body and if the child lives till puberty or longer, there is marked disproportion between the upper parts of the body and trunk and the lower extremities.

One of the most important secondary lesions of surgical importance is the so-called Arnold-Chiari malformation of the cerebellum and medulla oblongata. The medulla oblongata is elongated and extends downward into the spinal canal so that the lower part of the fourth ventricle is below the foramen magnum. As a rule the cerebellar tonsils are elongated and extend down into the spinal canal. Together with the lingula they are often plastered to the fourth ventricle and medulla with dense adhesions. The cranial nerves that arise from the pons and medulla are necessarily elongated and the upper cervical spinal nerves are also elongated and run cephalad to reach their exits at the intervertebral foramina. The elongation of medulla and cerebellum results in blocking of the lower end of the fourth ventricle and the adhesions of the cerebellar lingula and tonsils to the medulla and fourth ventricle obliterate the posterior cistern. Thus an obstructive hydrocephalus is produced. In the author's experience, this is the usual, if not the sole cause of the hydrocephalus so often seen in spina bifida. This is in agreement with the recent statements of Campbell.[1]

The mechanism of the malformation has been explained by Lichtenstein.[7] In spina bifida the spinal cord or membranes have an abnormal attachment to the surrounding and overlying tissues. Such an abnormal attachment can even exist (although not usually) in spina bifida occulta. It results in traction on the neuraxis above the level of the malformation as the spinal column elongates. The more rapid elongation of the spinal column in comparison to the neuraxis is well known. The spinal cord extends for the full length of the embryo during the early development, but from the fourth month on the vertebral column elongates more rapidly than the cord. At birth, the tip of the spinal cord reaches only to the third lumbar vertebra, and in the adult to the lower border of the first lumbar vertebra. Any abnormal attachment of the cord, nerve roots or meninges to the spinal column or overlying parts will produce traction on the neuraxis during both prenatal and postnatal growth. Thus, not only may the medulla and cerebellum be pulled down into the spinal canal, but the midbrain likewise may be elongated and pulled down into the posterior fossa. Thus a stenosis of the aqueduct of Sylvius may be produced and this may be one of the factors in the associated hydrocephalus.

Surgical opinion naturally varies on the selection of cases of spina bifida for operation and the proper time for intervention. It may be generally stated in spina bifida that a neurologic deficit which can be recognized early in life, will tend to grow worse with time, rather than improve. The continued traction on the neuraxis will produce symptoms in some cases late in puberty or adult life and will probably exacerbate symptoms already present. It is well known that hydrocephalus, if at first not apparent, may develop after a few months and what is worse, from the standpoint of the surgeon, may develop rapidly after operation on the spina bifida.

Cases of myelocele that show complete flaccidity of the lower extremities with no spontaneous movements and gaping with loss of tone of the rectal sphincter should not be operated on. These infants, even if life is preserved, will be hopeless invalids. Most of them develop varying grades of hydrocephalus and the rare case that survives to reach adult life is generally mentally retarded. If partial function of the lower extremities is present, operative repair may be undertaken, but the parents must be warned that permanent impairment of neurologic function will likely be present and that hydrocephalus may develop.

Meningoceles and cases of spina bifida with

lipoma should be operated on, but even here, the possibility of late neurologic sequelae should be explained to the parents and particularly that these sequelae are likely to include difficulty with control of the bladder or urinary retention.

No agreement exists about the proper time to operate. It is best to wait until the child is at least a month old. If the spina bifida is not covered with skin or epithelium at birth, it should be allowed to epithelize before operation. These infants should be nursed on their face with the hips elevated by a sandbag or a firm pillow. A diaper may be placed beneath the hips and legs. In this position excreta fall away from the spina bifida, the pressure is low in the spina bifida and drainage of the cerebrospinal fluid, if present, is lessened. Exposure of the unepithelized area under a light cradle usually is the best means of promoting epithelization. If there is superficial necrosis or infection, moist boric acid dressings or sulfathiazole ointment dressings may be used until clean granulations are obtained.

Occasionally it may be necessary to operate without further delay because of slowness in healing of a large unepithelized area or because of profuse cerebrospinal fluid drainage. In most of these cases there is complete loss of function of the lower extremities. However, in selected cases of this type, plastic repair of the spina bifida may be justifiable in order to facilitate the nursing care of the patient. Operation may make it possible to care for such a child at home, or in a nursing home, and thus free a hospital bed of a chronic hopeless case. This is the only exception to the previous statement that cases with complete loss of function in the lower extremities should not be operated on.

SURGICAL REPAIR

The principles of the operation are simple, but the performance may at times be very difficult. The base of the sac is encircled by an elliptical incision. This may be vertical in cervical and dorsal meningoceles, but in the lumbosacral variety, it should be transverse so as to keep it as high above the gluteal fold as possible. Where the skin is ample, the incision is planned to allow approximation without tension. If there is a large skin defect, the incision must spare all normal skin.

The skin and subcutaneous tissue are dissected back from the sac and the base of the sac mobilized. Then the sac is opened on one side (not at the top) and the contents inspected. If there is no myelocele, the sac may then be resected, leaving ample dura at the base for closure. Any nerve roots in the sac must be carefully mobilized, and returned to the spinal canal. If there is a myelocele, it must be carefully freed from the skin or epithelium above, and returned to the spinal canal.

In cases of large myelocele with extensive cleft in the vertebral arches the reconstruction of a membranous spinal canal is difficult and often not satisfactory. If possible, the rudimentary dura is approximated over the myelocele without tension. If the sacrospinalis muscles can be approximated across the midline, so much the better. If they cannot, then fascial flaps are fashioned by making lateral incisions in the lumbar fascia. These flaps have their base toward the midline. They are reflected and sutured across the midline, overlapping them if possible. This step should always be carried out, if it is not possible to directly approximate the lumbar fascia. Sometimes only relaxing lateral incisions in the lumbar fascia may permit its approximation.

When large skin defects are present, the closure of the skin may be a major problem. Usually some form of "Z" plastic is satisfactory; occasionally a pedicled flap may be required. In any case the operative area must be covered with viable skin sutured without undue tension. Failure to accomplish this will result in breaking down of the wound, often with establishment of a cerebrospinal fluid fistula.

In common with Ingraham [6] and Elsberg,[5] I have found no value in preserving the sac as a prophylaxis against hydrocephalus, as recommended by Penfield and Cone.[9] As a matter of fact, preservation of the sac is impossible in the more severe cases in which hydrocephalus is most apt to develop.

After operation these children are nursed

as before, on their face, with hips elevated. As soon as the wound is superficially healed, the sutures are removed, and the dressing left off. If there is poor wound healing, due to suture under tension, or other reason, the case is managed as an unepithelized preoperative case, with exposure under a light cradle and in cases of infection boric acid compresses or sulfathiazole are also indicated. In large or unepithelized defects, chemotherapy should be started three or four days before operation.

Complications. Hydrocephalus is the most serious complication of spina bifida. If it is present before operation, it should be dealt with first, if the case appears suitable for operation on the spina bifida. If the latter is not true, then hydrocephalus is merely an additional contraindication for surgical intervention. But, as Campbell [1] has pointed out, a patient when first seen may have mild hydrocephalus without serious cerebral damage and meningocele or myelocele without serious neurologic deficit.

In a considerable number of cases of spina bifida that are operated on, hydrocephalus may not be apparent before operation, but rapidly develops afterward. Whether the meningocele serves as a reservoir and thus obviates the enlargement of the head before operation or whether the shift in the cerebrospinal fluid pressure at the time of operation causes a further prolapse of the cerebellum and medulla into the foramen magnum with development of a complete block of the posterior cistern, is not clear. On a number of occasions we have injected indigocarmine into a lateral ventricle before beginning the repair of a spina bifida. Usually we have failed to recover the dye from the meningocele, indicating that a complete block already existed.

A number of surgeons, including D'Errico,[4] Campbell, and Naffziger and Boldrey [8] have reported favorable results with suboccipital decompression and opening of the fourth ventricle or posterior cistern. The mortality of these procedures has been disturbingly high in infants, and in my experience, the obstruction tended to recur after a few weeks or months. This has been especially noted in cases of the Arnold-Chiari malformation, where suboccipital exploration has been carried out a number of times without lasting relief of the symptoms.

It occurred to me that third ventriculostomy, as advocated by Stookey and Scarff [10] and by Dandy,[3] would be a better procedure in obstructive hydrocephalus, due to posterior fossa lesions. At first the anterior route, as advocated by Stookey and Scarff, was used with transfrontal craniotomy, intradural elevation of the frontal lobe after preliminary tap of the ventricle, and puncture of the lamina terminalis above the optic chiasm. While this procedure has proved satisfactory in my hands in a number of cases of inoperable fourth ventricle or midbrain tumors in older children and adults, for some reason it has not worked well in infants. Therefore a trial of the lateral approach as advocated by Dandy [3] was made. This has worked well and has now been carried out in five cases of obstructive hydrocephalus, associated with spina bifida and presumably due to the Arnold-Chiari malformation. These five cases have been observed from 12 to 18 months and the results have been excellent with cessation in the abnormal enlargement of the head, and absence of increased intracranial pressure.

A small, right temporal, osteoplastic craniotomy may be used or a small subtemporal decompression, using a musculocutaneous flap, may be utilized. If intracranial pressure is high the ventricle should be tapped before the dura is opened, to avoid danger of rupture of the cortex. Then the temporal lobe is elevated intradurally. A lighted retractor or a good headlight is essential. It may be necessary to clip or coagulate one or more communicating veins between the temporal lobe and the dura. At this point it is advantageous to lower the child's head slightly. As the temporal lobe is elevated, the incisura of the tentorium can be seen. Medial to this the oculomotor nerve will be seen and anteriorly the carotid artery. Behind the carotid artery and medial and superior to the oculomotor nerve the white lateral wall of the floor of the third ventricle is seen. This may be readily punctured with a bayonet forceps and the opening enlarged as desired. Needless to say, great care must

be exercised to avoid injury to the oculomotor nerve or to the carotid artery and its branches.

The dura should be sutured and the wound may then be closed in the usual manner. Dandy's suggestion of a preoperative encasement of the head in a plaster cast, to avoid collapse of the cerebral hemispheres after drainage of the ventricle, has neither logical basis or merit. The immediate postoperative care of these children is similar to that of craniotomies in general.

Cranium bifidum is much less common than spina bifida. Ingraham and his associates reported 84 cases of cranium bifidum at the same time that they reported 462 cases of spina bifida, a ratio of 1 to 5.5. In the author's experience the ratio has been approximately 1 to 5. These cranial defects are generally in the midline, although they may occur anywhere. They are most frequent in the occipital region. Ingraham *et al.* had 75 per cent of their cases in the occipital region. Cranium bifidum may be simple or have associated meningoceles or encephaloceles. The latter may represent heterotropia of various types. In one of my cases abortive reduplication of the brain was found in a large occipital meningocele. In severe cases surgery is obviously not indicated because of the serious associated cerebral malformations. Severe hydrocephalus is also a contraindication. In addition to a complete history and general physical and neurologic examination it is wise to carry out diagnostic air studies as an aid in the preoperative evaluation of these patients.

The surgical repair of these defects usually is not difficult as the cases that are suitable for surgical intervention as a rule are covered with sufficient normal skin. The occipital cases, which are the most frequent, usually have sufficient occipital muscle or fascia for an additional layer of closure in addition to the dura below and the skin above. Seldom can the contents of the sac, if an encephalocele, be returned to the intracranial cavity. They have to be sacrificed by amputation. The large encephaloceles are usually associated with other brain deformities and consequently are not amenable to surgery.

The repair of the cranial defect is not indicated in infancy. It may be repaired later on in childhood, especially if in the frontal region and producing a cosmetic defect. The occasional encephalocele or myelocele at the base of the brain presents a difficult problem that can sometimes be successfully solved as Dandy [2] and Ingraham and Matson [6] have shown. These authors have reported successful extirpation of such lesions, using an intracranial approach.

SUMMARY

Spina bifida and cranium bifidum are congenital defects in the vertebral column and skull that may be simple or may be associated with more or less severe neurologic defects. The surgical management of these lesions is not difficult but the selection of patients for surgery and the management of the neurologic complications may tax the skill and ingenuity of the most experienced surgeon. Each case must be carefully studied and its management adapted to its individual needs.

SOMMAIRE

La spina bifida et la bifida cranienne sont dûes à des défauts congénitaux de la colonne vertébrale et du crâne, cette malformation peut être simple ou associée avec des lésions plus où moins grâves du système nerveux. Le traitement chirurgical de ces lésions n'est pas difficile, mais le choix des malades pour la chirurgie et pour le traitement des complications névralgiques exige le talent et l'ingénuité du plus habile chirurgien. Chaque cas demande une attention soignée et le traitement doit être adapté aux indications individuelles.

RIASSUNTO

La spina bifida ed il cranio bifido sono anomalìe congenite che possono essere semplici difetti ossei, od essere associati ad anomalìe piu' o meno gravi del sistema nervoso. Il trattamento chirurgico non e' difficile: ma la selezione dei pazienti ed il trattamento delle complicazioni neurologiche possono mettere a dura provâ l'abilita' e l'intraprendenza del chirurgo. Ogni caso va studiato a parte, e la scelta della cura adattata alle singole necessita'.

SUMARIO

La espina bifida y el craneo bifido son defectos congenitales que pueden ser simples o estar asociados con defectos congenitales del sistema nervioso central. En general el tratamiento quirurgico de estas lesiones no es dificil. Sin embargo la seleccion de los pacientes para la cirugia y el tratamiento de las complicaciones neurologicas pueden hasta taxar la ingenuidad del cirujano mas experimentado. Cada caso debe de ser estudiado con gran cuidado y su tratamiento debe de ser individualizado.

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Progress in the Treatment of Hyperthyroidism*

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THE recent additions of thiouracil, propylthiouracil, and radioactive iodine to the armamentarium of those interested in the treatment of hyperthyroidism has greatly stimulated interest in this subject. At the last meeting of the American Association for the Study of Goiter held at Toronto in May, two days of the three-day program were devoted largely to a discussion of these new therapeutic agents.

Interest in this subject had been waning in recent years because of inability to find more successful methods of dealing with toxic goiter. Plummer's great contribution of Lugol's solution in 1922 [1] had revolutionized the treatment of exophthalmic goiter, but results with its use in the therapy of toxic adenoma had proved disappointing. In 1936 Freeman and I [2] reported that in a study of 279 patients with toxic adenoma 38 per cent were made worse by iodine, while 62 per cent were either not affected or only slightly improved. Thus, prior to the discovery of thiouracil by Astwood [3] in 1943, there was no effective agent to be used either in the preoperative or postoperative care of these patients. The mortality rate in the surgical treatment of advanced cases of this type remained comparatively high even in the hands of the most experienced thyroid surgeon. In the patient desperately ill, digitalis, oxygen, transfusions, and other agents were all used unsuccessfully. A two-stage operation was needed to assure the patient's recovery.

The discovery of the antithyroid drugs brought about as remarkable results in the treatment of these cases as had Lugol's solution in exophthalmic goiter. It has been shown repeatedly that after several months of preparation with these drugs patients with the most advanced type of multiple toxic adenoma can be operated upon with little more risk than the nontoxic patient. At the Chicago meeting of the American Medical Association this year I demonstrated an exhibit on this subject, and the question was repeatedly asked, "When are these patients ready for surgery?" There is no fixed rule by which one may judge when a thyroidectomy may safely be performed. If one must err, treatment should be continued over too long rather than too short a period. With proper precautions and frequent checks of the patient's condition no harm will be done.

For the past two years I have not used thiouracil, believing that equally good results will be obtained with propylthiouracil, a far safer drug. While no fatalities have been reported either in Europe or this country with the use of the latter drug, cases of agranulocytosis have occurred, so that the white blood cell count should be checked every three weeks and the patient warned of a possible reaction, such as skin eruption, fever, gastrointestinal upset, and sore throat.

PROPYLTHIOURACIL

Toxic Adenoma. There is no special reason for using this drug in preparing the mildly toxic patient for surgery. One's experience must tell him whether or not the patient is a good surgical risk. Certainly in these patients the basal metabolic rate is not an index of the degree of operative risk. A patient may have a rate of only +25 per cent but may still be a poor surgical risk because of severe cardiac, vascular, renal, and liver changes. If there has been little loss of weight and strength and if the hyperthyroidism is of short duration, the patient may probably be operated upon without preliminary preparation with propylthiouracil. If in doubt, the drug should be given and for not less than six weeks. Then, if the patient has shown considerable improvement and if all tests are satisfactory, operation may be safely performed after three weeks' treatment with Lugol's solution. In more serious cases the period of preparation may require many months. One should always remember that the advice of Charles Mayo concerning exophthalmic goiter to the effect that "It never

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requires an emergency operation," may now also apply in toxic adenoma. It is better to take too long rather than too short a time to prepare these patients for thyroidectomy.

Propylthiouracil has one distinct disadvantage; it makes the operation technically more difficult, despite preoperative iodine therapy, because with its use the gland becomes more friable and more vascular. Rather than continue iodine over long periods of time in the preoperative treatment, we have reserved its use for the two or three weeks preceding thyroidectomy. Longer use of iodine has not eliminated the disadvantages of propylthiouracil and has increased them by delaying the advantageous effects of the drug.

Dosage in Toxic Adenoma. Another question frequently asked is that regarding the dosage of propylthiouracil. Again the treatment cannot be standardized but must be suited to the individual patient. In a series of 175 patients with hyperthyroidism whom we treated with propylthiouracil, the average dose administered was 50 mg. three times a day. Others have used considerably larger doses with possibly quicker results in some instances but ultimately with the same outcome. The question arises as to whether or not a larger dosage is potentially more dangerous. I do not know, and I doubt if enough is known about the action of this drug to answer this question positively at this time. I do know that, as was the case in using thiouracil, by using conservative doses of propylthiouracil no serious reactions were observed in my series. One young physician asked why I did not use 400 or 500 mg. of the drug, so that I could obtain more spectacular results such as he believed he was obtaining. My answer was, that I would never give anything to a patient that I would hesitate giving a member of my family.

From what knowledge we have, it does seem that the drug may be given with comparative safety in doses up to 200 or 300 mg. a day. Probably the size of the drug is not the factor that causes the reaction; rather, it is the individual's sensitivity to it. When thiouracil was in vogue, it was known that the drug might be used for months without harm, but that after resumption of it following a rest period, a serious and at times fatal reaction might occur. The number of persons killed by this drug will never be known, but there were a great many, and not all of them were patients with hyperthyroidism. This drug should never have been released for general distribution but should have been continued on a research basis until the far safer propylthiouracil was available.

Propylthiouracil, then, is of paramount importance in the preoperative treatment of toxic adenoma. There seems to be no indication for its use postoperatively. There rarely is recurrence of this form of toxic goiter.

Exophthalmic Goiter. What of the use of propylthiouracil in exophthalmic goiter? One might first go back to 1922 when Plummer showed the remarkable effect of iodine in the preoperative preparation of this disease. Great was the skepticism regarding this revolutionary change in the concepts of that day. I recall submitting a paper to the *Journal of the American Medical Association* in 1923 on the use of Lugol's solution in the preoperative preparation of exophthalmic goiter, and having the paper returned because it was considered too radical a departure from the generally accepted theories. This paper, published the same year in *The American Journal of Surgery*, was a review of ideas I had gained as a student of Plummer's, together with a review of 30 of my own cases.[4] Shortly thereafter attention was directed to the great value of iodine in the postoperative period, to its effect of causing the hyperplastic gland to revert to a colloid state, to the danger of its prolonged use preoperatively, for which the name "iodine-fast" exophthalmic goiter was suggested, and to the greater value of large, rather than small, doses in the immediate postoperative care.[5-8] Attention was also called to the possibility of initiating hyperthyroidism in nontoxic adenoma by the injudicious use of iodine, and the term "iodine hyperthyroidism" was suggested for this syndrome.[9] In 1925 it was shown that the use of iodine made unnecessary the then popular ligation operation and that primary thyroidectomy was a safe operation for exophthalmic goiter.[10]

During the ensuing years many contributions to the treatment of exophthalmic goiter were brought forth. For a few years roent-

genotherapy had many supporters, but the sum total of various studies showed that while the disease might be partially controlled, it was seldom cured by this method. Then for a time denervation of the adrenal gland received popular acclaim. Soon, however, this operation fell into disrepute, as it failed to obtain results. So down through the years iodine remained the method of choice until thiouracil was developed. For a while it seemed that this drug might be the answer to the long sought nonsurgical method of cure. Not only did this prove to be a false hope, but the drug actually resulted in a higher mortality rate from the disease than did surgery. Then came propylthiouracil, and we are about able to say that the percentage of cases that may be cured with this drug is so small that this method is only justified from a research standpoint. Out of 75 patients whom I treated for a period of from 6 to 12 months with this drug all but 3 had a recurrence of symptoms when the drug was discontinued. At present I am studying a smaller group of cases that have been on the drug for nearly two years, and there is a possibility that some of these cases may be cured, or rather arrested. Bartels [11] stated that this drug will not cure exophthalmic goiter.

In the past six months I have largely abandoned the use of propylthiouracil in the preoperative treatment of exophthalmic goiter, except in severe or complicated cases. The average case is now prepared as formerly with iodine for 10 to 14 days; then a primary thyroidectomy is performed. In addition to the other disadvantages in using propylthiouracil, there is the prolonged delay which is objectionable to some patients. On the other hand, we are continuing to try it in certain persistent and recurrent cases, in children, and in the aged. It might be indicated in a pregnant woman after six months.

OTHER DRUGS

At this time there is little to suggest that methylthiouracil will prove any more effective. What about radioactive iodine? Perhaps one might best summarize the reports of practically all the pioneer investigators who were represented on the last program of the American Goiter Association for the Study of Goiter. Radioactive iodine has proved disappointing in the treatment of cancer of the thyroid; few, if any, such patients have been cured, because only certain areas of malignancy are destroyed. It holds considerably more promise in the treatment of exophthalmic goiter. While most investigators have been cautious about reporting cures, Means,[12] who directed the Boston group's studies, reported that radioactive iodine may totally ablate the thyroid gland and thus terminate hyperthyroidism, but what the end results will be is still to be determined. Certain patients may develop myxedema, and Means stated that even the development of malignancy cannot be excluded. Further study of much larger series of cases will be necessary before an accurate appraisal of the value of radioactive iodine in the field of thyroid therapy may be made.

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Androgens in Gynecology

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SINCE the isolation and clinical application of the androgens there has been a controversy concerning the use of these hormones in women. Some gynecologists and endocrinologists maintain that the male hormone has no place in the treatment of gynecologic disorders, but others believe the androgens are decidedly helpful in overcoming some disorders of the female genital tract. I have found several indications for the use of androgens in women.

The male hormone, testosterone, resembles the corpus luteum hormone, progesterone, in many of the physiologic responses to its use. On this basis, androgens are being administered to overcome certain gynecologic disorders. It has been shown conclusively that testosterone, the male hormone, or its derivative, testosterone propionate, is capable of inducing proliferation of a progestational character of the endometrium in rabbits and rats.[1] Like progesterone, it will inhibit uterine contractions induced by estrin,[2] maintain pregnancy following the excision of the ovaries, and delay parturition in the normal pregnant rat.[3] Furthermore, it is effective in neutralizing vaginal and uterine responses to estrin and is capable of completely suppressing spontaneous estrus cycles in rats and mice.[4] It is significant that testosterone propionate is four to eight times more active than progesterone in the latter reaction, being effective in doses of 0.05 to 0.1 mg. daily.[5]

Other effects have been obtained in primates by injections of testosterone propionate. Zuckerman[6] induced ovarian atrophy and endometrial involution in monkeys while menstruation was completely suppressed throughout the duration of treatment. In normal women, Hartman[7] and Papanicolaou, Ripley and Shorr[8] have obtained similar results.

It was suggested that some gynecologic disorders which on a theoretical basis should respond to progesterone, might also respond to androgenic therapy. In this regard painful breasts and dysmenorrhea first received the attention of gynecologists.

Desmarest and Capitaine[9] report excellent results in these conditions. The ability of testosterone to suppress menses suggested its application in the treatment of excessive uterine bleeding. Loeser,[10] who was a pioneer in the use of androgens and who has made many valuable contributions to the subject, injected doses of 50 mg. of testosterone propionate every other day into patients with menorrhagia and was able to control the flow. He maintained that about 500 mg. during the month was necessary to suppress the menstrual bleeding until the next period, while 300 mg. postponed the menses for about eight to ten days. Biopsies of the endometrium revealed that this tissue had undergone atrophy. Loeser noted also that fibromyomas decreased in size significantly under this therapy. He obtained beneficial responses also in two cases of chronic cystic mastitis and in several cases of dysmenorrhea, using somewhat smaller doses (150 to 300 mg.).

Additional information regarding the therapeutic value of testosterone propionate was reported by Foss[11] who treated 16 cases of excessive menstrual bleeding of functional origin with excellent results in most instances. The dosages which he administered were quite large, 300 to 800 mg., and he injected as much as 2,000 mg. in resistant cases. Ovulation was inhibited as indicated by endometrial biopsies. Foss noted that several patients under androgenic therapy developed hot flushes and other symptoms of the menopause. The beneficial effect of testosterone on excessive bleeding was further confirmed by Geist, Salmon and Gaines,[12] who obtained gratifying results in 24 out of 25 cases and by Mazer and Mazer[13] who reported excellent results in uterine bleeding.

My results[14] confirm the observation of others that in the human being, testosterone propionate inhibits ovarian activity with the suppression of uterine bleeding and involu-

tion of the accessory sex organs, including the breasts, uterus, and vaginal mucosa. Fibromyomas, which are also under the influence of the ovary, regress. These anatomic changes persist only as long as the patient is under the influence of the androgen. It is apparent that the mechanism by which testosterone propionate produces these changes is not through its progestational action, since changes typical of progesterone have not been demonstrated in the endometrium but through suppression of ovarian activity. It is not unlikely that the therapeutic results which are claimed for progesterone itself are due to this response rather than that of the endometrium. As a matter of fact, the significance of endometrial changes in ovarian dysfunction has been frequently postulated but never conclusively demonstrated for such common disorders as menorrhagia or dysmenorrhea. One may find any stage of endometrial development from the resting phase to the secretory. The fact that normal secretory endometrium is frequently found in patients with excessive menstrual flow indicates that this bleeding is not due to the lack of corpus luteum activity as is commonly believed. Hence, the proposed therapy of this condition with progesterone is not on a sound basis. In reality, evidence indicates that relatively large doses of progesterone, amounting to 100 mg. or more in the last ten days of a cycle, are usually ineffective in controlling uterine bleeding.[15] The concept that functional bleeding is due to endometrial hyperplasia might also be abandoned, since it has been sufficiently demonstrated that hyperplasia is not as frequently associated with menorrhagia as formerly believed. In fact, hyperplasia is often seen in cases of amenorrhea or in women with normal menstrual cycles. The attempt to control excessive flow should therefore not consist primarily of attempting to alter the endometrium, since it seems quite possible that there is no correlation between excessive bleeding and histologic changes of the endometrium. It is my belief that we must look elsewhere than the endometrium for the etiology of these ovarian dysfunctions and the explanation for the therapeutic responses in these conditions.

The mechanism by which testosterone propionate influences the ovarian function in human beings has been suggested by Foss to be through its action in suppressing pituitary activity, on the bases of the endometrial changes which he obtained in the human being. Geist has considered the modus operandi of this substance to be somewhat complex and in some respects paradoxical. For instance, in primates testosterone induces ovarian inactivity and subsequent involution of the accessory sex organs, while in the rodent, it produces progestational proliferation, uterine hypertrophy, and persistent corpora lutea in the ovaries.

These seemingly contradictory findings have, however, been explained by Freed, Greenhill, and Soskin,[5] who have demonstrated a biphasic effect of testosterone propionate on the pituitary of the rat. Small amounts were found to inhibit the pituitary follicle-stimulating hormone, resulting in ovarian atrophy and subsequent uterine involution due to lack of estrin. Large doses released the luteinizing hormone, resulting in persisting corpora lutea and a similar suppression of estrin. The uterus underwent hypertrophy, however, because a large dose of androgen is capable of acting directly on the uterus in the absence of estrin as in the castrate rodent. It was suggested, therefore, that the involutionary changes in the reproductive organs of human beings resembled the reaction to the small doses of androgen in the rat. The doses chosen for therapy apparently are relatively small for the human being when compared with that in experimental animals. The findings of Engle and Smith[16] that 25 mg., but not 5 or 10 mg., of testosterone propionate injected daily is capable of inducing a progestational endometrium in monkeys support these conclusions.

From my results and those of other workers in this field, it is not unreasonable to conclude that male hormone therapy has definitely beneficial effects in certain gynecologic disorders. At the present time testosterone propionate has been used with considerable success in the following gynecologic disturbances:

Menopause. The male hormone should be

used instead of estrogens to overcome the distressing symptoms of the menopause in women who had a breast or other organ removed for cancer, in women who have had pelvic endometriosis and in women who bleed when they take estrogens. I usually prescribe a 10-mg. tablet of methyl testosterone daily but some women may have to take two tablets a day. In some cases I combine the male hormone with very small doses of estrogen (0.25 mg.) to overcome the menopausal symptoms. The addition of the androgen to the estrogen usually prevents uterine bleeding in menopausal women who have this tendency.

Dysmenorrhea and *Painful Breasts.* In the treatment of dysmenorrhea and painful breast, suppression of the menses is not necessary to obtain the desired results. It seems that complete ovarian suppression is not essential for some therapeutic responses, and it is possible that the direct antagonism of estrogen by the male hormone plays a role in the treatment of mastopathies and dysmenorrhea.

This neutralizing property of testosterone propionate has been demonstrated both in histologic responses of estrogen and in its myometrial activity. It is possible that the alleviation of dysmenorrhea is on the basis of inhibiting uterine muscle contraction. This explains the results obtained with the injection of 150 to 250 mg. of testosterone propionate in the last two weeks of the cycle wherein the pain was relieved but the menses were not disturbed. This dosage may, in certain cases, be insufficient, however, and injections during the entire month may be required in the severe cases to induce a temporary menopause in order to relieve the pain. I prefer diethylstilbestrol to testosterone for the relief of dysmenorrhea because it is far simpler, considerably less expensive and much more effective.

Endometriosis. Not only may the dysmenorrhea associated with and the constant pain due to endometriosis be relieved by androgens, but also the endometriotic masses may be made to decrease in size temporarily. I have kept quite a few young women comfortable and postponed operation by giving 25 mg. of testosterone propionate hypodermically three times a week for four weeks. Then after three or four months, another course of injections must usually be given, but the patient can be left relatively free of pain for years by means of this intermittent therapy.

Premenstrual Tension. By this I mean a group of symptoms which some women have 7 to 10 days before menstruation, and these symptoms include a distended abdomen, swollen, painful breasts, headaches, jitteriness, nervousness and so on. A 10-mg. tablet of methyl testosterone for each of the last 10 days usually relieves this premenstrual tension. It may be added here that the androgens usually have a tonic effect on women.

Excessive Uterine Bleeding. In the treatment of menorrhagia it seems fairly conclusive that large amounts of testosterone propionate such as 25 to 50 mg. hypodermically, three times a week, are required so that ovarian activity is completely suppressed. I have observed several cases where sufficient testosterone propionate was administered to prevent ovulation as detected by endometrial biopsies, but this did not prevent or delay the menses significantly. Ovulation can be inhibited with approximately one-half the amount necessary to suppress menstruation (anovular menstruation). While it is apparent that testosterone propionate has an effect on the pituitary gland and ovaries, it is still not understood why beneficial responses often continue following cessation of testosterone propionate injections. The explanations must await further investigations as to the mechanism of menstruation and the etiology of menstrual disorders. In many cases I use estrogens instead of androgens to control excessive menstrual bleeding.

Mittelschmerz or Intermenstrual Pain. The pain which occurs about half way between two menstrual bleedings and which is believed to be due to ovulation may in some cases be prevented by giving 25 mg. of testosterone propionate hypodermically 3 or 4 times or 10 mg. by mouth daily in the first 14 days of the cycle.

Metastases after Cancer of the Breast. The pain which women have from metastases in the spine and elsewhere after radical breast surgery may be relieved by hypodermic or oral preparations of androgens. If taken by mouth at least 50 to 100 mg. of methyl tes-

tosterone must be taken daily and hypodermically, at least 50 mg. must be given two or three times a week. Of course, these women will develop signs and symptoms of virilism, but the pain will be relieved. In women past 60 years of age I use estrogens instead of androgens to relieve the pain of metastases from cancer of the breast.

Sexual Frigidity. In most women who have no sex desire, 25 mg. of testosterone propionate given hypodermically three times a week for four weeks will arouse the sex instincts. This may be due to the effect of the androgen on the clitoris.

In an occasional case of *uterine fibromyomas* where there is profuse bleeding and where an operation is not to be performed, 25 mg. of testosterone propionate given hypodermically 3 times a week for three or four weeks will stop the uterine bleeding. If the androgen therapy is continued, not only will the bleeding cease but the fibromyomas will decrease in size. Soon after the treatment is stopped, however, the fibromyomas will increase in size again. Hence, such therapy is only temporary in effectiveness.

Lactation may sometimes be suppressed by giving 20 to 25 mg. of testosterone propionate hypodermically daily for 3 days, or 100 mg. methyl testosterone by mouth daily for 3 days. Puerperal women do not often show signs of virilism, even when given large doses of androgens, just as they rarely have disagreeable side effects when they take diethylstilbestrol.

Caution must be exercised in administering testosterone propionate as it has already been demonstrated that virilism (hirsutism, change in voice and slight enlargement of the clitoris) can be induced in some women who receive more than 250 mg. of this substance.[17] Likewise, some women gain weight and develop an acneform eruption. Most of these disagreeable side-effects disappear slowly after the hormone treatment is stopped, but some may persist for six months or longer. These undesirable features of androgenic therapy may possibly be eliminated with the development of newer preparations which may retain the effectiveness of testosterone propionate but not the masculinizing activity of this substance.

SUMMARY

The male hormone, testosterone, resembles the corpus luteum hormone, progesterone, in many of its physiologic effects, and on this basis, the androgen is being administered by some gynecologists to overcome certain gynecologic disorders. Testosterone propionate, a derivative of testosterone, is being used with considerable success in the following gynecologic disturbances.

In the menopause the male hormone should be used instead of the estrogens to overcome distressing symptoms in women who have had a breast or other organ removed for cancer, in women who have had pelvic endometriosis, and in women who bleed when they take estrogens. To produce relief from dysmenorrhea and painful breasts it is not necessary to give large doses because there is no need to suppress ovulation.

Not only may the dysmenorrhea associated with, and the constant pain due to, endometriosis be relieved by androgens, but also the endometriotic areas temporarily decrease in size. The androgens are almost a specific cure for premenstrual tension. In excessive uterine bleeding large doses of testosterone propionate must be administered in order to suppress ovarian activity completely. Some cases of Mittelschmerz or intermenstrual pain are benefited by small doses. Huge doses must be administered to produce relief from pain due to metastases from cancer of the breast. Sexual frigidity requires large doses. The beneficial effect may be due to the effect of the androgen on the clitoris. In an occasional case where there is profuse bleeding associated with uterine fibromyomas and where an operation must be postponed, large doses of androgen will not only stop the bleeding, but will bring about a slight reduction in the size of the fibromyomas, though this reduction is only temporary. In lactation the supply of breast milk can be suppressed by small doses of androgen.

Caution must be exercised in administering testosterone propionate because if large doses are used, virilism (hirsutism, change in voice and slight enlargement of the clitoris) will be induced. On the other hand, this androgen is an excellent tonic for many women.

SOMMAIRE

L'hormone testostérone masculen ressemble á l'hormone du corps jaune de l'ovaire, progestérone, sous beaucoup d'effets physiologiques, et se présente sur cette base. L'androgéne est employée par certains gynécologistes dans le traitement de plusieures affections gynécologiques.

Dans le ménopause, l'hormone mâle peut être employée au lieu de l'estrogéne dans le traitement des symptomes douloureux ches les femmes dont a emputé le sein ou fait l'ablation d'autres organes pour le cancer, aussi chez les femmes qui ont souffert d'endométriose pelvienne et chez les femmes qui saignent après avoir pris des astrogénes.

Dans le traitement de la dysménorrhée et de seins douloureux, il n'est pas nécessaire de donner de fortes doses car il n'est pas indiqué de supprimer l'ovulation. Non seulement la dysménorrhée et les douleurs mammaires qui accompagnent l'endométriose sont controlée par les androgénes, mais aussi la superficie des plaques endométriotiques est diminuée temporairement.

Les androgénes sont presque spécifiques et curatifs pour la tension prémenstruelle. Dans les hémorragies utérines excessives, il importe d'administrer de fortes doses de testorénone propionate afin de supprimer toute activité ovarienne. Certains cas de douleurs intermenstruelles cédent á l'emploi de petites doses. Il faut employer de grandes doses pour soulager la douleur dû aux métastases consécutives au cancer mammaire.

La frigidité sexuelle nécessite de fortes doses. Il est probable que les effets bienfaisants sont dûs á l'action des androgénes sur le clitoris. Dans les quelques cas d'hemorragie excessive dûes aux fibrimyomes utérins et oû il est sage d'ajourner l'opération, de fortes doses d'androgéne non seulement arrêteront l'hémorragie mais améneront une réduction temporaire dans le volume du fibrome. Par rapport á la sécretion lactée, de petites doses d'androgéne aupprimeront la lactation.

C'est avec prudence qu'on doit employer le testostérone proprionate parce que de fortes doses produisent le virulisme (hirsutisme, altération de la voie et augmentation de volume du clitoris).

Sous d'autres rapports, l'androgéne est un excellent tonique pour beaucoup de femmes.

RIASSUNTO

Il propionato di testosterone e' somministrato con notevole successo nelle seguenti disfunzioni ginecologiche: In menopausa, allorquando i disturbi funzionali insorgono in pazienti operate di carcinoma; allorquando figurino—nell'anamnesi—sintomi di endometriosi; oppure allorquando la somministrazione di ormoni estrogenici abbia provocato delle perdite di sangue dai genitali. In talune forme di dismenorrea o di sindromi dolorose della mammella. In questi casi la somministrazione di testosterone deve limitarsi a delle piccole dosi, in quanto non occorre una vera inibizione dell'ovulazione.

Se la dismenorrea e' associata o legata ad un'endometriosi, gli ormoni maschili trovano un'indicazione particolarmente utile, in quanto inibiscono lo sviluppo dell'endometriosi. Per eliminare la cosidetta "tensione" premestruale. In talune metrorragie funzionali. In questi casi la dose degli ormoni maschili deve raggiungere un livello tale, da sopprimere completamente l'attivita' ovarica. Nelle donne soggette a dolori intermestruali, dovuti allo scoppio dei follicoli ovarici. In questi casi gia' delle piccole dosi di testosterone rivelano una notevole efficacia.

Allorquando insorgano delle metastasi secondarie ad un cancro della mammella. In questi casi occorrono delle dosi molto elevate di testosterone per attenuare l'intensita' dei dolori.

Per ridurre la frigidita' sessuale. In questi casi gli ormoni maschili, in forti dosi, sembrano esercitare un'azione stimolante sopra il clitoride. In talune menorragie associate a fibromiomi dell'utero, nelle quali l'operazione deve essere posposta per qualche controindicazione. Larghe dosi di testosterone possono non solo frenare le emorragie, ma ridurre — almeno — temporaneamente—il volume dei tumori. Per sopprimere la secrezione lattea bastane delle piccole dosi di ormoni maschili.

La somministrazione di testosterone va sorvegliata attentamente onde evitare — specie allorquando si tratti di dosi elevate — l'insor-

genza di irsutismo, cambiamenti della voce, ed un aumento di volume del clitoride. Il propionato di testosterone e', daltra parte, un eccellente tonico per molte donne.

SUMARIO

La hormona masculina, el testosteron, resembla a la hormona del cuerpo luteo, la progesterona, en muchas de sus acciones fisiologicas y por esta razon se administra en ciertos desarreglos ginecologicos.

En la menopausia la hormona masculina se usa para corregir los sintomas que acarrea en las mujeres que hayan sido operados por cancer del pecho o de otra region, o que hayan padecido de endometriosis y por ultimo en las mujeres que tienen tendencia a sangrar del utero cuando se les administra productos estrogenicos. En el tratamiento paliativo de la dismenorrea y de la congestion dolorosa de los pechos. En estos casos no es necesario el dar doses elevadas para asi no suprimir la ovulacion. Las hormonas androgenicas no solo alivian el dolor de la dismenorrea y el que coexiste con la endometriosis sino que tambien disminuyen temporalmente el tamano de las regiones de la endometriosis.

La hormonas androgenicos son casi una cura especifica en el tratamiento de la tension premenstrual. En las hemorragias uterinas se deben de administrar doses elevades del propionato del testosteron para asi suprimir completamente la ovulacion. Ciertos casos de dolor intermenstrual se mejoran con pequenas doses.

En el cancer del pecho se deben de dar doses muy elevadas para controlar el dolor de las metastases.

En el tratamiento de la frigidez se deben de administrar doses altas. Su beneficio posiblemente se debe a su accion el clitoris. En ciertos casos de hemorragia uterina con fibromiomatosis del utero y en los cuales es necesario el postponer la operacion, doses elevadas de la hormona masculina no solo paran la hemorragia sino que muy frecuentemente traen la disminucion temporal en el tamano del tumor. Pequenas doses son efectivas en la supresion de la lactacion.

El testosteron se debe de administrar con cuidado por cuanto doses elevadas pueden producir el virilismo en la mujer. No obstante es un tonico excelente mara muchas mujeres.

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Suction Drainage Era in Surgery

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SEVERAL years ago in one of my earlier articles on this subject [1] I spoke of the beginning of the use of drainage and stated that the surgical literature would eventually be rewritten when drainage became available. The intervening years have shown that drainage as it is now accomplished has added a safety factor to surgery in many fields, aids in the reduction of mortality from surgical infection, and improves morbidity figures.

HISTORY

It is unfortunate that surgeons have not been more careful in the use of the word "drain" in surgery. I am unable to find the origin of the use of the word in surgical literature but it may have been used first in fields wherein the force of gravity was available, such as colpotomy. In the dictionary "drain" is defined as "to empty, draw out, remove or evacuate." On reflection, one is compelled to agree that in surgery gravity has been the only source of energy available to surgeons in the past. The laws of physics do not change. Some of these laws state that (a) fluids will not run "uphill" unaided; (b) fluid seeks its own level; (c) pressure of fluid is equal and the same in all directions; (d) hydrostatic pressure of a column of fluid is greatest at the lowest point and definite and measurable; (e) to create a column of fluid there must be a surrounding wall to support it and pressure on this wall is measurable. Accepting these physical laws as true, we may ask where, when, and how have we applied them to surgical fields, except when gravity was utilized.

"Capillary action" is so infinitesimal that its value has been nullified as has been proved by the gradual disuse into which wicks have fallen with the general surgeon. The statement from scores of surgeons that "I do not use drainage now as patients seem to get along just as well without it" is only too true. Since wicks never accomplish drainage the results could not be materially different. Wicks or vents are *not* drains. Webster's dictionary defines vent as "an opening to permit the escape of a fluid or gas" and a wick as "a device to maintain the permanency of the vent." Both of these are passive. Probably there are no surgeons today who have not at sometime in their lives been in contact with conditions or problems, whether on the farm, in the mine, the factory, the laboratory or the home wherein they were not confronted with the problem of draining something. The farmer puts a pump in his well to empty it; the engineer puts a pump in the cesspool to empty it; the oil worker puts a pump in the "sump hole"; the laboratory worker uses aspiration (suction) to withdraw fluid; the sailor uses a bilge pump to suck up fluid. No wicks (Penrose) were ever used in any of these fields. The *surgeon uses a wick in the cavity* with or without a preformed wall—"uphill"—and calls it a drain. It might be added that it is not a question of volume. The farmer wants volume, it is true, probably to water his stock. The surgeon is not so much interested in volume, but the fluid even in cubic centimeters is of sufficient importance that it may cause the loss or the saving of a life.

DEVELOPMENT OF SUCTION DRAINAGE

It is difficult to understand how a piece of gauze, rubber tissue or tube placed in a cavity pointing upward could be considered a drain. *It does not suck out or empty.* After much study of the problem I have never used the word "drain" when it applied to a passive structure. Because of that trend of thought I have been able to develop, with much outside help from colleagues and engineers, a method of drainage that drains. It is now available in hospitals throughout the world and with its use the mortality from infection should be appreciably reduced.

TECHNIC OF SUCTION DRAINAGE

Device to Accomplish Drainage. It is known that wicks permit an overflow only

when the cavity is completely filled, and increase the area of infection a hundred fold or more by permitting it to spread in all

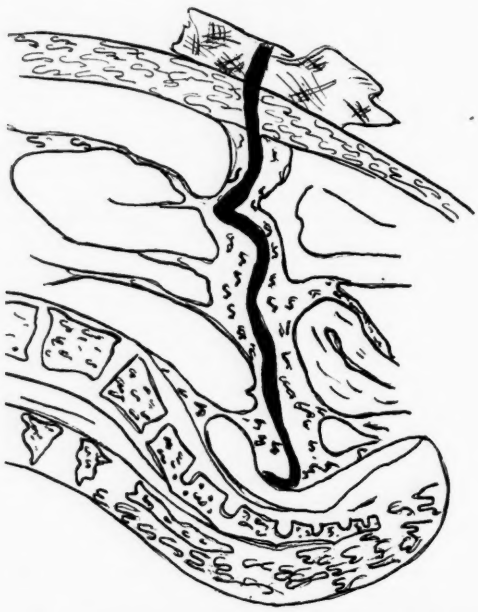

Fig. 1. This is to illustrate what a Penrose wick will *not* do in any abdominal cavity. Shaded area is collection of pus and serum flowing in every direction except "straight up." When the area is completely filled a small portion will overflow on the gauze. The area of infected tissue is increased many fold. This new infected area accounts for most postoperative temperature and sepsis. A suction tube in this cavity prevents new infection and removes all secretion from the bottom.

directions, contaminating clean tissue and finally directing the infection into the incision and the wound itself. This, of course, is highly undesirable. What was wanted was a means of sucking out the infection from its source at the lowest existing level and thereby preventing the spread of infection. It is a well-known law of physics that fluid cannot be sucked out of a cavity or container (i.e., bottle with drinking tube) where air is not admitted. That is necessary in the surgical cavity. A suitable tube has been designed (Chaffin drainage tube) which permits free circulation of air by suction energy and no suction can occur on the eyelets of the tube and adjacent tissues. This can be demonstrated as outlined in Chart 1. After years of experimentation and study, we have

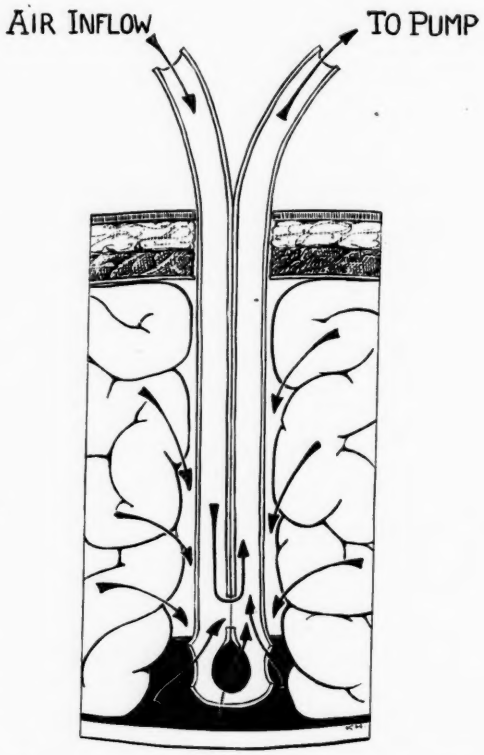

Fig. 2a. Graphic illustration of a Chaffin tube in the abdomen, surrounded by loops of intestine. It is approximately 8 inches long with an inside diameter about five sixteenths of an inch. Large arrows show direction of peritoneal secretion by gravity to lowest point—bottom of "well." Small arrows show fluid entering tube to be aspirated by the pump. Air flows in freely in "open limb," through by-pass and out other limb, as shown. There is no suction on eyelets.

produced a tube (one size) that fits any and all cavities and fields and fulfills the necessary requirements. Nothing escapes around the tube. The infection remains in its original location and is rapidly reduced with no spread to the clean tissue and incision. The infected field is irrigated (auto-irrigation) by peritoneal secretion or the tissue serum forming the wall of the cavity and is "sucked out" continually. This permits the tissues

(and patient) to assume the offensive at once, and recovery and healing begin immediately. In the peritoneal cavities (the field of greatest usefulness) few or no adhesions are formed, canalization or gross wound infection does not occur, and metastatic or secondary abscesses have not been observed. The drainage is often applied to the several reservoirs of the abdomen at the same time, as in general peritonitis in late ruptured viscera and pancreatitis (Fig. 4). Prophylactically it may be used to protect nearly all intestinal anastomoses, especially surgery of the large bowel.

Fig. 2b. New type of tube now in use. Shows Penrose "tails" attached which direct fluid to "low point" to be sucked out. This type of tube drains a wide area of infection and increases effectiveness of the Chaffin tube in suction drainage.

Energy for Producing Suction. In a long struggle to find a source of suction energy, during which numerous devices were tried, including the "water bottle gadgets" as these are used today by the profession, none was found adequate to operate the Chaffin tubes. In this mechanical age they may all be considered as belonging to the horse and buggy era since they are all unscientific, impractical, inefficient, slow, and require constant nursing attention and are too frequently nonoperative.

Our engineers have developed an electric unit capable of doing all the things we find necessary and consider important: it is noiseless, trouble-proof, and constructed to operate two suctions (half gallon size collection bottles) at the same time. We are assured that the Chaffin tube will be kept in constant operation, permitting of no clogging, and with one bottle attached to the Levin tube, we are assured of a completely empty stomach, allowing the patient to drink any

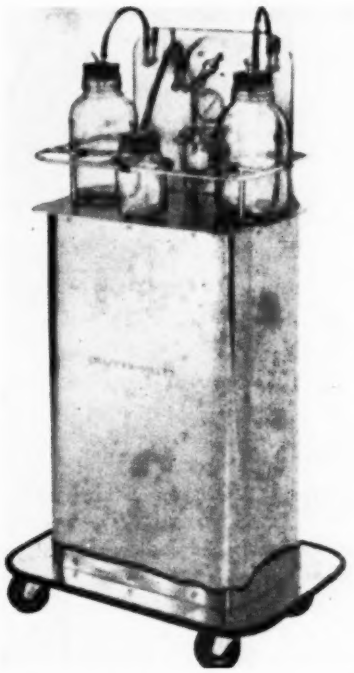

Fig. 3. Photograph of new bedside pump. Has two 2-quart collection bottles with negative pressure equal to 30 inches of water (2 inches of mercury) suction on each. We use one for nasal tube and other on Chaffin tube. If more Chaffin tubes are used we attach another pump. There is a small bottle for "high suction" for throat mucus. A gauge shows degree of suction at all times. The suction on the large bottle cannot be increased by nurse. There is an automatic "shut off" when bottles overflow. Constructed for continuous operation day and night for years without attention. Silent so it does not disturb patients in a ward.* This appliance competely covers the medical and surgical suction requirements of any hospital.

* Manufactured by E. O. Pratt Company, Los Angeles.

amount of water, which he greatly enjoys. When he has drunk a half gallon of water, or less, the nurse empties the collection bottle. The Chaffin tube and Pratt pump comprise the two elements necessary to carry out this technic of suction drainage (Fig. 5). The surgeon need only place a tube in the surgical field, secure it to the skin with a silkworm suture and the nurse at the bedside will attach the pump (Chart 2).

CLINICAL APPLICATION

Below are discussed conditions and surgical fields in which suction drainage may serve to reduce serious complications and deaths, as well as lower the incidence of morbidity, shorten convalescence and lessen sequelae such as adhesions, chronic sinuses, and persistent fistulas.

Acute Cholecystic Disease. What is said here is not to be interpreted as a contro-

CHART 1. METHOD OF DEMONSTRATING THE CHAFFIN DRAINAGE TECHNIC WITH THE CHAFFIN TUBE

1. Obtain a tall drinking glass or similar glass container (wide mouthed glass bottle).
2. Insert a Chaffin tube to the bottom.
3. Pack one rubber glove well around the tube (do not kink the tube).
4. On top of this pack in gauze loosely.
5. Fill with water and you now have a closed abdominal cavity with intestines and omentum. The water is the peritoneal fluid, the gauze furnishes the secretion.
6. Apply suction to either limb of the tube and observe the complete emptying of the fluid from the gauze and from between the loops of intestines (glove). This is the peritoneal secretion and will be completely withdrawn in a few minutes (auto irrigation).

Water bottle suction gadgets will not operate this drainage as it is too slow. In the experiment use the operating room suction or a water faucet pump.

Mr. E. O. Pratt of Los Angeles designed a bedside pump as a source of energy for these tubes and I know of no other. This pump energy is just as necessary as the electrical or hydraulic suction in the operating room is to operate the Pool Tube or the tonsil suction.

Contrast this experiment with the same set-up with the Penrose Wick. Canalization (infection fibrosis) does not occur because the pus comes out through the tube and not around it as with a wick.

A single tube with suction will not operate because intestines are sucked into the end of the tube, causing damage and no removal of the fluid.

CHART 2. TECHNIC IN THE USE OF THE CHAFFIN TUBE IN SURGERY OF THE ABDOMEN

1. At surgery, place a tube in any cavity or reservoir wherein there is undesirable secretion, or where it may occur. This tube is to replace all Penrose or other wicks.

   Example: Place tube in

   1. All gallbladder surgery, in drainage of the gallbladder. Insert in gallbladder and "purse-string" in the usual manner.
   2. Below the gallbladder (duct surgery).
   3. Gastric resection (near duodenal stump in case of leakage and to prevent subdiaphragmatic and other infections in this area.
   4. Pancreatitis (a) gallbladder, (b) lesser cavity, (c) pelvis, (d) right gutter.
   5. Appendix abscess and pelvis, if questionable infection of this field (most important).
   6. Urinary bladder, to keep empty and dry. Urinary bladder and outside if traumatic rupture.
   7. All other fields that require drainage (uphill).
   8. Protects all fields of colon surgery, resection or anastomosis.

2. Close wound tight up to the tube. We usually exit the tube through stab wounds and not incision.

3. Suture tube to skin with silkworm and tie in bowknot.

4. Test both limbs of the tube with operating room suction before leaving operating room. Leave ends of tube outside of dressing.

5. Attach Pratt Pump or other large volume :low pressure suction to one limb of the tube at bedside for continuous suction with Murphy drip can to other limb and slow drip of sodium chloride.

6. In 24 to 48 hours untie the bowknot and loosen tube, pull up a little and replace. Air entering tube is disregarded, even in clean cases, as no infection will occur.

7. There will be no need for further attention for the duration of drainage (2 days to 2 weeks). The average abscess of appendix requires about 5 to 7 days.

8. Use small dressing on abdomen so tube can readily be inspected for kinks, etc.

9. Dressings will not be soiled and wound not grossly infected. In 2 or 3 days drainage cases the "drip" is not required, if you change suction from limb to limb to prevent drying of tubes.

versy between drainage and cholecystectomy. Rather, this may be considered a form of treatment of the acutely ill patient to save

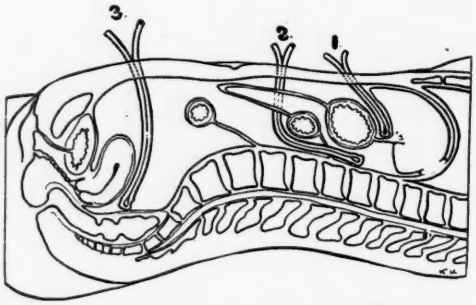

Fig. 4. Shows location of suction drainage tubes in draining abdomen with acute pancreatitis. (1) liver space, (2) lesser peritoneal cavity, (3) pelvic drain. Suprapsoas reservoir may also be drained by other tubes through stab wounds if these are found to contain peritoneal fluid. One limb of each tube is attached to pump for suction.

his life and prevent complications, thereby greatly reducing the mortality of this disease. Cholecystectomy can always be done at a future time.

The acute gallbladder should be opened aseptically with trocar and contents aspirated, stones removed and a Chaffin tube inserted. A second Chaffin tube should be inserted below the gallbladder. If the gallbladder becomes gangrenous and sloughs away completely, nothing will happen to the patient because all secretion is controlled with Chaffin tubes and no peritonitis (chemical or bacterial) will result. This early surgery will almost entirely prevent the deaths from ruptured and gangrenous gallbladders. The slightly damaged gallbladder will recover earlier and more completely with suction drainage because it is kept entirely empty at all times and the mucous membranes may make an early recovery.

Chronic Cholecystitis. In all cholecystectomies a tube should be placed near the gallbladder bed for 24 to 72 hours. All cholecystectomies leak bile (Frank H. Lahey,[3] Arthur Allen[4]). How much bile leakage occurs may be learned through suction drainage. We obtain 50 to 150 cc. of highly colored serum from every gallbladder field. Suction drainage prevents the local bile peritonitis which occurs in cholecystectomy with nondrainage or when wicks are inserted. We formerly tried wicks or closures but now protect all with a Chaffin tube (Fig. 2b).

Biliary Passages. In all duct surgery there is bile leakage and such cases should be protected with suction drainage. A wick stimulates serum secretion, mixes it with bile and after it fills Morrison's pouch a little will come out into the incision (to impair healing) and appear on the dressing. This is not drainage, but an overflow.

Liver Abscess. Hepatic abscesses should be drained as soon as diagnosed. Pus should be evacuated aseptically with trocar and Pool tube and Chaffin tube inserted to achieve a continually empty cavity and early recovery (Fig. 6). The avenue of approach is not important because the surgery is aseptic and there is no danger from the "spill," a condition always present with the overflow passive type of attempted drainage. Several cases recently reported by Bean[5] were treated with this technic with prompt early recovery. No contamination of the peritoneum occurred and liver repair took place early because of a completely empty cavity from the moment of its evacuation till healed.

Pancreatic and Duodenal Resection. This is a very important field for drainage as we are dealing with duodenal secretion, pancreatic enzymes and bile. An operation well done with multiple anastomoses cannot always give the best results and may result in complete failure if the chemical peritonitis prevents the healing of suture lines. Suction drainage may serve to insure against this eventuality by removing all fluid and leaving the suture line dry instead of submerged in a pool of serum. If leakage occurs, it will be directly into the suction bottle.

Gastric Surgery. Two dangers in the field of gastric surgery are from suture leakage and from subdiaphragmatic infection. The duodenal "blow-out" has always been a menace and a danger. When it occurred, death usually resulted from bile peritonitis. The anastomosis leak at the upper angle is also a critical point and this results in a subdiaphragmatic infection or worse. A suction tube placed in this field for five or six

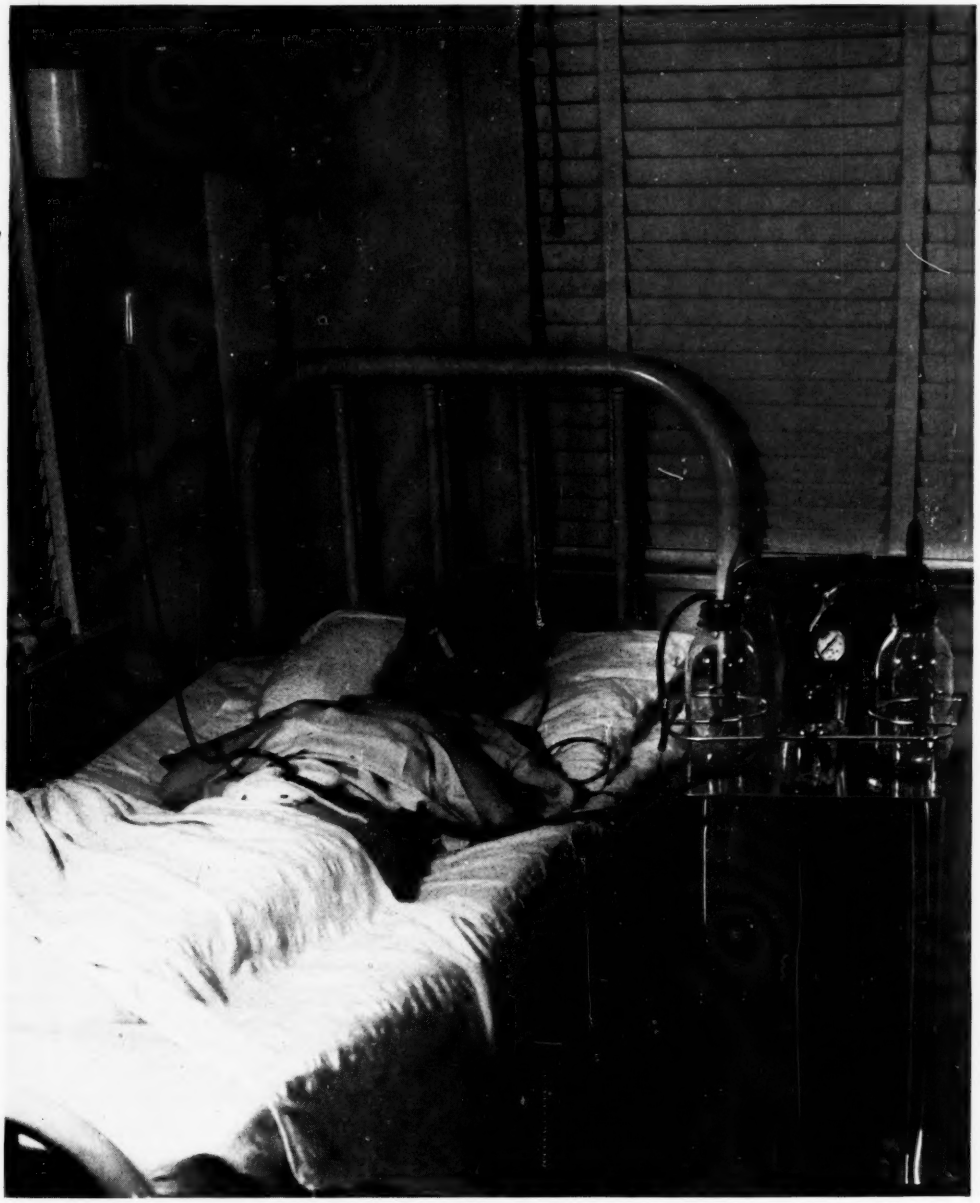

Fig. 5. Photograph of patient with pump operating the Levin tube to one bottle of pump and abdominal drainage to the other. The "Murphy Drip Can" keeps the tubes clean for weeks. Saline in clean cases and Dakin's solution in foul cavity drainage.

days will take care of leakage, and fistulas have cleared in a few days after removing the tube. We have seen these cases treated in this manner.

Large Bowel. Since the advent of sulfonamide compounds as bacteriostatic agents the technic of colon surgery has improved to the point where one-stage resection is common. The best technic and skill will not prevent the occasional leak due to tissue necrosis of vessel thrombi, and when it occurs the result is either a fatal peritonitis or a large abscess with a fistula. Protect these anastomoses with two tubes for a few days and the patient's safety is assured. With the use of suction drainage we have done *both right and left one-stage resections* for over 20 years. Exteriorization technics which formerly were employed to avoid infection may be rendered unnecessary when the hazard of infection is eliminated.

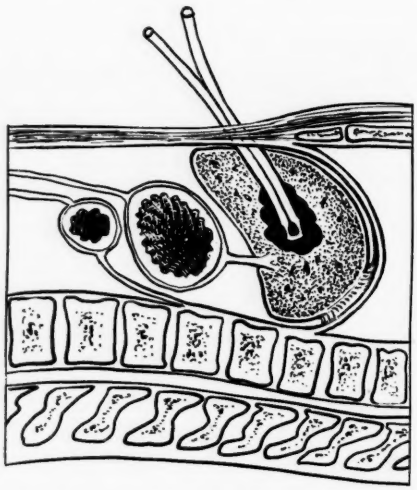

Fig. 6. Placing a Chaffin drainage tube in liver abscess especially indicated because the direction is "up-hill" and this tube permits of no leakage or contamination of peritoneal cavity.

Small Bowel. Anastomosis of the small bowel is a much safer procedure than anastomosis of the large, but leakage does occur and we often protect these with a tube.

Appendicitis. The overall mortality in appendicitis continues much too high, though large surgical centers individually have reduced the mortality. All the peritoneal cavity wants from the surgeon is a little help in taking out the gross infection and the patient will do the rest. Since the institution of suction drainage in our hospital for one year our mortality in appendectomies has been zero. In the case of ruptured appendix with abscess, the pelvis should nearly always be drained as well as the right gutter and at times Morrison's pouch in the case of high abscess. Two tubes are an average and three are not too many.

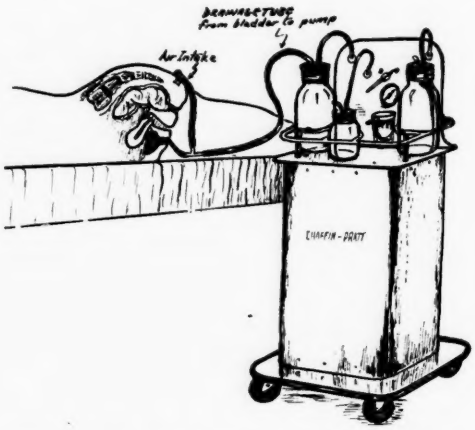

Fig. 7. Catheter in place with tube over thigh to prevent kinking; "T" tube to admit air. Suction should not stop during entire postoperative treatment (about ten days).

Pelvic Infection. Abortion or other acute infections of the pelvis, formerly so dangerous, will usually improve with chemotherapy. Those who do not yield to chemotherapy in 48 to 72 hours should have a suprapubic Chaffin tube inserted down to the bottom of the pelvic cavity. Recovery usually may be expected in a few days. Many cases of the gonorrheal type of infection yield to chemotherapy but abscess formation is not uncommon. These should be drained early per abdomen by a Chaffin tube.

Genitourinary. All bladder surgery comes into the field of suction drainage, including vesicovaginal fistula.[2] Complete drainage of the bladder after repair of vesicovaginal fistula as outlined by me some 25 years ago has completely revolutionized the technic. With adequate drainage (first with the Bradford frame as originally reported by me and now with suction and the "frame" eliminated

(Figs. 7, 8, 9)) the percentage of cures is very high. All suprapubic bladder surgery requires suction drainage for the best results.

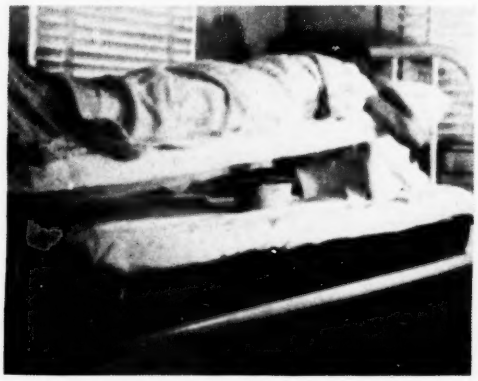

Fig. 8. Photograph shows patient on Bradford Frame with catheter dropping down into pan for a completely empty bladder. Bradford Frame no longer necessary. Patient placed on face in bed and Pratt suction pump and "T" tube arrangement produces better drainage and greater comfort.

Water will not run "uphill." Any bladder that has been sutured is definitely safer if it contains no urine at any time than one that is full and "running over" as is always the case in single-tube drainage; the incorrectly-called siphon. For the past 20 years we have used suction drainage in suprapubic prostatectomies and always have *dry* patients with early closure. The new subpubic or retropubic case also heals more kindly and earlier and remains dry with suction drainage. Rupture of the bladder either into the peritoneal cavity or pericystic tissues is not a serious problem. Two tubes, one in the repaired bladder and one in the abdomen or tissues will assure an early healing. The *sutured bladder cannot leak if it contains no fluid.* Serum secretion will wash out extravasated urine if we will remove it.

Ureters transplanted to the sigmoid should be protected with one or two tubes to prevent peritonitis in cases of suture leakage or gas "blow-out." I have seen both occur with this tube protection and the fistula closed in five days.

Kidney Surgery. All surgery of the kidney pelvis and ureters should have the protection of suction drainage because urine is very irritating to the tissues and invites infections. The direction is "uphill." The Chaffin tube

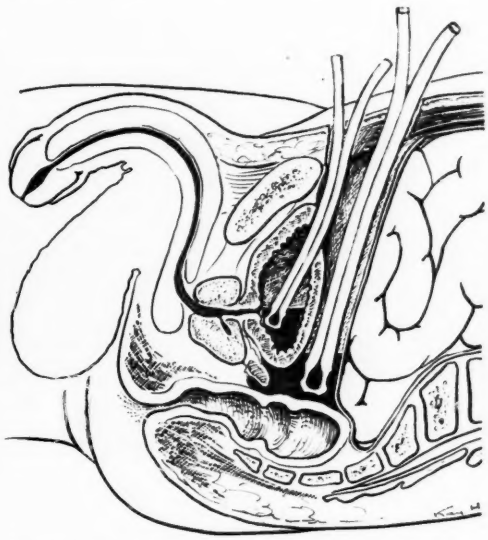

Fig. 9. Use of suction tube in bladder injuries or resection done for any purpose—as posterior diverticulae. One tube keeps bladder entirely empty so no leakage of suture-line can occur, and other is in posterior perivesical space, preventing any infection or extravasation in this most dangerous territory. If rupture has occurred into abdomen, the peritoneal pelvis would be drained by another tube.

will keep the interior of the wound dry and permit no extravasation. *All* urine (in pelviotomies) is collected and the amount of leakage is therefore known day by day. This is not possible where vents with wicks and dressings absorb the "overflow."

There are many other fields of surgery where suction drainage is applicable but I have mentioned a few of the common and most important ones and those in which the mortality and morbidity can be greatly reduced. The disuse of wicks of any sort and the substitution of drainage is rapidly changing the whole conception of what surgical drainage means.

SUMMARY

Drainage has been defined and its mechanics and physics explained. It has been shown

that wicks do not drain and will not cause fluid to flow "uphill." The use of drainage has greatly reduced the number of deaths occurring in any hospital where the technic is used and the equipment is available. The technic has been so simplified that any operator of limited experience can do as safe an operation in infected fields as the better trained surgeon. Visceral leakage is a hazard to surgery and drainage will guard this type of surgery. Earlier recovery will be the rule when drainage is used as compared with closures or vents.

Economy is an important factor as few dressings are necessary with suction drainage since all secretion is in the bottles. Wounds are not grossly infected as all secretion comes through the tube, not around it. Adhesions are less because the area between the infection and the surface is not grossly contaminated.

An improved type of Chaffin tube is now in general use which increases the area drained and the general efficiency of the tube compared with the original one.

CONCLUSIONS

We have shown that wicks and vents are not drains. We have described a simple efficient method of accomplishing real surgical drainage that was not heretofore possible. The more important fields of surgery have been described as well as the method by which the therapeutic and prophylactic use of drainage can be applied to these fields. Mortality is greatly reduced—probably 90 per cent—by use of drainage. Morbidity has been greatly reduced by this means—surgical drainage by constant suction of the fluid from the infected cavity.

Recovery and healing are dependent on the physiologic process of tissue secretion (autoirrigation) and healing is active and progressive from the hour of surgery if the secretion is sucked out.

SOMMAIRE

Nous avons démontré que les mèches et les tubes ne sont pas des drains. Une méthode très simple et efficace pour obtenir un drainage vraiment chirurgical qui jusqu á present n'était pas possible vient d'être décrite. La mortalité est grandement diminuée, probablement de 90% par l'emploi du drainage. La morbidité aussi est diminuée par l'emploi de la technique Chaffin. Le drainage chirurgical doit obtenir la suction constante du fluide des cavités affectées. Nous avons démontré que le traitement et la guérison dépendent sur le procédé physiologique de secrétion tissulaire (auto-irrigation) et la guérison est consécutive et progressive, si dès le commencement le drainage par suction peut être appliqué. Dans le cholecystite aigüe et chronique, dans les abscès hepatiques, dans les affections biliaires, dans les résections pancréatiques et duodénales et dans la chirurgie de l'estomac de l'intestin grêle et du gros intestin, de l'appendice, des infections génito-urinaires et des maladies rènales, on aura recours à cette méthode.

SUMARIO

Hemos mostrado que los drens de mecha no ofrecen verdadero drenaje. Se ha descrito un metodo muy simple y muy eficiente de drenaje quirurgico. Con el la mortalidad se ha reducido por lo menos un 90%, lo mismo que la morbilidad. Hemos tambien demostrado que el recobramiento es dependiente del proceso fisiologico de secrecion de los tejidos (autoirrigacion) y que los procesos de regeneracion y de reparacion son activodos desde el momento que se comienza la succion de las secreciones. El tratamiento de drenaje por succion es de valor en la cirugia de las vias biliares, abcesos del higado, en las resecciones del duodeno y del pancreas, en la cirugia del estomago intestinos y colon, y en las infecciones genito-urinarias.

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Editorial

Italy—Mother of Medicine*

HIPPOCRATES, as is well known, has been called the Father of Modern Medicine in recognition of his establishment of medicine as a science based on observation of disease and a careful recording of its manifestations in the human body. The transfer of the center of medical advancement from Greece to Rome was the result of the development in Italy of leaders who created a new epoch in medical progress.

Today the name of Vesalius, who studied in the scientific atmosphere of Italy, is recognized universally as the father of anatomy, a subject among the most important of the basic sciences upon which modern medicine has developed and grown. William Harvey, known for his basic research on circulation of the blood and recognized as one of the ten greatest names in medicine of all time, was an Englishman imbued with the spirit of medical science and research in the school in Padua. As economic and social conditions have changed, the center of medical research and advancement has changed with them, but regardless of political, social or economic vicissitudes, the spirit of investigation and research has remained alive in Italy, and Italian scientists have contributed notably and continually to medical advancement. The name of Forlanini as the creator of pneumothorax is one of the most significant in the record of our progress against tuberculosis. The genius of Bastianelli and Putti has been everywhere recognized for their contributions to surgery and particularly to rehabilitation and reconstruction of those disabled by accidents, by injuries, and by wars.

Today Italy has been considered especially appropriate as a place for the meeting of international congresses because of its traditions of scientific medical advancement in the past and equally because of the manner in which its medical institutions have survived two recent devastating wars. The contributions to gynecology of Emilio Alfieri and the work of the Cancer Institute in Milan have attracted medical recognition. From less well known Udine came operations on the spinal ganglia by Pieri. The universities in Rome, Milan and Trieste still continue to attract great numbers of visitors who are interested not only in contributions to modern medical science but also in the background of culture and medical tradition which make all of Italy a shrine for the medical visitor.

The death of the renowned surgeon, Professor Mario Donati, was recognized throughout the world as a major loss to medical progress and the American medical profession has expressed interest in the development of the library established by the Donati Foundation as a center for the preservation of his own collection of books and periodicals and for contributions from other nations to aid the creation of a center where medical studies may be carried on.

In Italy, Antonio Carle (1854–1927), a pupil of Billroth, did valuable work on the brain, the thyroid, the gastrointestinal and biliary tracts, but was still more important for the influence that his school at Turin had on the general progress of Italian surgery. Among Carle's distinguished pupils were R. Gallazzi, director of the orthopedic clinic at Milan; M. Donati (1879–1946) of Milan who contributed to advances in surgery of the parathyroids, the abdomen and the sympathetic nervous system; and O. Ufreduzzi of Turin who wrote on peripheral sympathectomy and hermaphroditism, and also G. M. Fasiani of Milan, eminent as a brain surgeon. A. Carle in 1882 demonstrated the transmissibility of tetanus.

Genius is not the exclusive property of any nation, of any race or of any creed. Wherever it arises it deserves the support of all mankind. The contributions of Italy have benefited the world as a whole and the great debt that the world owes to these geniuses of Italian medicine for their contributions must be acknowledged.

MORRIS FISHBEIN

* Presented at the Sixth International Assembly, International College of Surgeons, Rome, May 18–24, 1948.

News Notes

CHAPTER NEWS

Austrian Chapter. The Austrian Chapter of the International College of Surgeons was formed by a group of prominent Viennese surgeons at a recent meeting called for that purpose in that city. The following officers were elected:

President: Prof. Dr. Hans Finsterer, Head of the Department of Surgery, Allgemeines Krankenhaus, Vienna.

Vice-President: Prof. Dr. T. Antoine, Head of the Gynecological Clinic, University of Vienna.

Secretary: Prof. Dr. Felix Mandl, Head of the Department of Surgery, Franz Josef Spital, Vienna.

Treasurer: Prof. Dr. R. Demel, Head of the Department of Surgery, Rudolf Spital, Vienna.

Prof. Dr. Felix Mandl, Secretary of the Austrian Chapter and member of the International Board of Trustees of the International College of Surgeons, has been offered the chair of Surgery at the University of Graz, Austria.

Argentine Chapter. Prof. Dr. Augusto Wybert, F.I.C.S., has been elected President of the Surgical Society of Buenos Aires for 1948–1949.

Finnish Chapter. The Finnish Chapter held a special meeting on August 23, 1948, at the Bors Club in Helsinki. The meeting was held in honor of Dr. J. E. M. Thomson, of Lincoln, Nebraska, who addressed the group and spoke about the activities of the International College of Surgeons in the United States.

Dr. Atso Soivio read a paper on the treatment of cleft palate in Finland, his work and experience with about 1,000 cases. Dr. Soivio is Surgeon in Chief of the Cleft Palate Hospital in Helsinki, and a specialist in plastic surgery.

Mexican Chapter. The Eighth National Assembly of Surgery of Mexico was held at the Hospital Juarez in Mexico City Nov. 14 to 20, 1948. The following Fellows of the International College of Surgeons participated: Prof. Dr. Jesús N. Noyola, M.I.C.S., representing the Faculty of Medicine of San Luis Potosí; Dr. Alberto Enriquez S., F.I.C.S., representing the Board of Trustees of the Medical-Surgical Society of Chihuahua; Prof. Dr. Ramon Osorio Carvajal, F.I.C.S., the University of Yucatán; Prof. Dr. Mariano Vásquez, F.I.C.S., the General Hospital of Mexico; Prof. Dr. Raul A. Chavira, F.I.C.S., the Mexican Society of Ophthalmology; Prof. Dr. Ricardo Labardini Nava, F.I.C.S., and Prof. Dr. Manuel A. Manzanilla, F.I.C.S. (Hon.), the Secretariat of Health and Public Assistance of Mexico.

Prof. Dr. Gustavo Argil, F.I.C.S. (H.C.), and Prof. Dr. Francisco Fonseca, F.I.C.S. (Hon.), took part in the activities of the Third Mexican Congress of Medicine held in Mexico City in November, 1948.

Panamanian Chapter. Prof. Dr. Daniel Chanis, Jr., F.I.C.S., National Regent of the Panama Chapter, International College of Surgeons, was recently elected Vice President of the Republic of Panama.

Prof. Dr. Manuel A. Manzanilla, F.I.C.S. (Hon.), Vice President of the International College of Surgeons, was decorated on October 5, 1948, by the Government of Panama, with the National Order of Vasco Nuñez de Balboa, degree of Commander. Prof. Manzanilla was invited by the Government of Panama, as a guest of honor of the Republic, and during a proper ceremony in the Ministerium of External Relations, the citation was read in the presence of a number of distinguished officials of the Government of Panama and of his Excellency, the Ambassador of Mexico. The citation stressed the merit of the recipient of this honor, and his scientific contributions to surgery.

United States Chapter. On September 30, 1948, the *Alabama Surgical Section* of the International College of Surgeons, the Southern Research Institute, and the Jefferson County Medical Society sponsored a joint meeting in the Auditorium of the Jefferson-Hillman Hospital in Birmingham. An outstanding program was presented, with nationally known speakers, including Dr. Herbert Acuff, Knoxville, Tennessee; Dr. F. Bayard Carter, Durham, North Carolina; Dr. James Barrett Brown, St. Louis, Missouri; Dr. Edgar Davis, Washington, D. C.; Dr. Allen Voshell, Baltimore, Maryland; Dr. William Dameshek, Boston, Massachusetts; Dr. W. N.

Jones and Dr. Albert E. Casey, Birmingham, Alabama; Dr. J. U. Reeves, Mobile, Alabama.

Sir Archibald McIndoe, plastic surgeon of London, England, attended as the guest of Dr. James Barrett Brown. Sir Archibald contributed an interesting discussion of the panel system as practiced in England. Dr. Kenneth Cuyler of Duke University, guest of Dr. F. Bayard Carter, spoke on "Cytologic Diagnosis of Cancer."

The meeting was well attended, with 166 registrations, and again as many who did not register.

The afternoon meeting was followed by an interesting tour of the Southern Research Institute of Alabama. In the evening a banquet at the Tutwiler Hotel was attended by about 120 guests.

The program was concluded with a very interesting and educational lecture by Dr. William Dameshek on "The Spleen and Hypersplenism."

The first annual meeting of the *Wyoming Section* was held in Laramie, Wyoming, on August 31, 1948. Headquarters and registration were at the Connors Hotel.

Officers of the Wyoming section are:

President.....Dr. H. L. Harvey, Casper
Vice-President.....Dr. V. R. Dacken, Cody
Secretary-Treasurer..Dr. L. S. Anderson, Worland
State Regent..Dr. W. Andrew Bunten, Cheyenne

Committee on Arrangements was:

Dr. Lee W. Storey, Laramie
Dr. J. D. Shingle, Cheyenne
Dr. Herbert L. Harvey, Casper
Dr. W. Andrew Bunten, Cheyenne

Program

9:00 A.M.: Registration.
10:00 A.M. to 12:00 Noon: Dry Clinics presented by members of Albany County Medical Society
12:15 to 1:45 P.M.: Luncheon.
2:30 P.M.: Hyperparathyroidism, by Dr. B. Marden Black, Mayo Clinic, Rochester, Minnesota.
3:00 P.M.: Hirschsprung's Disease, motion picture presentation, by Dr. Max Thorek, Chicago, Illinois.
3:30 P.M.: Anomalies and Pathology of the Gallbladder and Bile Ducts with moulage demonstrations, by Dr. Nolie Mumey, Denver, Colorado.
4:00 to 4:30 P.M.: Discussion of all papers.
4:30 to 5:30 P.M.: Business meeting and election of officers for the coming year.

A smoker was held in the evening in conjunction with the Wyoming State Medical Society.

The Spring Clinical Conference of the *New Jersey Section* was held on Wednesday, May 19, 1948, at Jersey City Medical Center.

Officers:

Dr. John J. Connolly, President.
Dr. Watson B. Morris, Regent.
Dr. Charles M. Robbins, Vice-Regent.
Dr. Theodore Bender, Vice-Regent.
Dr. David Allman, Vice-Regent.
Dr. Earl J. Halligan, Vice-Regent.
Dr. Ernest F. Purcell, Vice-Regent.
Dr. Frank S. Forte, Secretary.

Program

10:00 to 11:00 A.M.: Registration and inspection of the Jersey City Medical Center.
11:00 to 12:00 Noon: Inspection of Pathological Museum.
12:00 Noon to 1:00 P.M.: Luncheon at Bruno's.
1:30 P.M.: The So-called Harmless Gallstone, by Dr. Edgar Burke, Chief Surgeon, Jersey City Medical Center.
2:00 P.M.: Total Gastrectomy in Carcinoma of the Stomach, by Dr. Earl J. Halligan, Consulting Surgeon, Jersey City Medical Center.
Splanchnic Anesthesia in Gastrectomy, by Dr. Norman Kornfield, Anesthetist, Jersey City Medical Center.
2:45 P.M.: Endometriosis with Case Review, by Dr. Charles B. Kelly, Consulting Gynecologist and Director of Surgery, Jersey City Medical Center.
3:30 P.M.: Volvulus of the Small Intestines in the Newborn, by Dr. Kenneth Judy, Attending Surgeon, Jersey City Medical Center.
4:15 P.M.: Comments on Meig's Syndrome, by Dr. Edward F. Sciorsci, Attending Surgeon, St. Francis Hospital, Jersey City.
5:00 to 6:00 P.M.: Cocktail Hour at Bruno's.
6:00 P.M.: Dinner at Bruno's.

New Books

British Surgical Practice. Edited by Sir Ernest Rock Carling and J. Paterson Ross, with a staff of consultant and associate editors, London, Butterworth & Co., St. Louis, C. V. Mosby Company, vol. III, 1948. The first two volumes of this series were reviewed in the October, 1948, issue of this *Journal*. The same general remarks are equally applicable to this volume. The subject matter ranges from Caesarean Section to Eyelids, and is handled in a comprehensive and crisp manner.

Five further volumes will complete this series which will represent a valuable compendium of surgical information.

A Short Practice of Surgery. By Hamilton Bailey and R. J. McNeill Love. Part Two. London, H. K. Lewis & Co., 1948. Current difficulties in England have unfortunately necessitated the piecemeal publication of the eighth edition of this concise, British, classic work. The overwhelming favorite of British medical undergraduates, it is gradually increasing in popularity in America as a general textbook of elementary surgery. This popularity is deserved, for the book has been written by two of England's most famous teachers of surgery and into it they have poured the fruits of their tremendous personal experience. Shorn of verbosity, the subject matter is presented succinctly and lucidly and the style is warm and personal.

Part Two deals with the gastrointestinal tract, including the pharynx and peritoneum, and excluding herniae. Each topic is handled in a concise, yet comprehensive manner, and where necessary, it has been thoroughly revised and brought up to date. The chief usefulness of the work is to serve as a vade mecum for the student, and as a quick source of reference to the practitioner who occasionally performs surgery.

Surgery of the Colon and Rectum. By Sir Hugh Devine and John Devine, Baltimore, The Williams & Wilkins Company, 1948. It is growing increasingly evident that the current trend in medical literature veers in the direction of the monograph. This is perhaps the natural outcome of the detailed knowledge that specialization has brought about. Only in a book whose range of topics is rigidly curtailed can the subject matter receive the meticulous consideration that its clinical importance may warrant. This is particularly true where there is but a single or perhaps two authors. Otherwise, the only alternative is to prepare a text written by a host of eminent collaborators, each a specialist in his chosen field. The final result is, of course, an aggregation of separate monographs, each being subservient to some editorial master-plan. Such a system is undeniably very useful, but the smaller, single monograph is becoming ever more popular with the medical profession.

In this connection the Doctors Devine have brought out a work which deals with a subject of paramount surgical importance: the large bowel, from cecum to rectum. The authors have dealt with their topic in a most comprehensive manner, stressing the urgency of early diagnosis, and choice of safer surgical procedure in any given instance. They base their opinions largely upon their own vast personal experience, although their conclusions are in agreement with surgical opinion both here in America as well as in England. The text can therefore be taken as authoritative. Indeed the senior author has already made an indelible impression upon modern surgical teaching.

To anyone interested in an exhaustive account of the surgery of the large bowel and rectum, this book is unreservedly recommended.

Traitement Chirurgical du Cancer du Rectum. By Francois D'Allaines. Paris, Editions Médicales Flammarion, 1946. This French book is an excellent monograph on surgical therapy of rectal malignancy, with a strong plea for the employment of the sphincter-preserving procedures whenever possible. The material is based largely on the author's personal experience, but he has made ample reference to workers from other countries. Of particular interest is the able rebuttal that d'Allaines provides to W. B. Gabriel's objections to conservative resections.

The serial illustrations depicting the various operative methods are excellent and the analytical tables are clear.

This work is yet another example signifying the rising tide of European medical progress freed from the harassing effects of war. It is highly recommended for the general surgeon as well as for the specialist.

Textbook of Surgery. By Frederick Christopher and contributors, Ed. 4, Philadelphia, W. B. Saunders Company, 1947. This well-known work is perhaps the most representative book on American surgery that one could find. The authors are culled from every part of the country, and their reputation and ability give unquestionable authority to their contributions.

The book has been designed primarily to impart the principles of surgical practice to medical undergraduates. The authors have achieved their goal with eminent success, since they have covered the entire range of surgery in a most comprehensive manner. Operative technic is not included in the discussion, however, and surgical therapy is only briefly outlined.

The really serious drawback to such a large work as this is that by the time the book reaches print, some portions are already outmoded, and recently developed items of incontestable importance have been omitted. Thus this edition contains no account of vagotomy, retropubic prostatectomy, the Rh factor, cardiac surgery, portocaval or lienorenal shunts and streptomycin, to mention only several of the more obvious omissions.

Nonetheless the reviewer regards this text as the best of its kind on the market, after making due allowance for its unavoidable limitations. It is recommended as a teaching text to all medical students, and as a compendium of ready reference to more advanced workers.

Textbook of General Surgery. By Warren H. Cole and Robert Elman, Ed. 5, New York, D. Appleton-Century Company, Inc., 1948. The appearance of the fifth edition of this excellent work since its inception 12 years ago will readily attest to its value and popularity. While primarily designed for the medical undergraduate, the general practitioner and even the surgical specialist could well profit from a perusal of the text. The roster of contributing surgeons contains names which are outstanding in contemporary American surgery.

The general plan of the earlier editions has been preserved, but much new material has been added and the remainder revised, in some instances quite extensively. Operative technic has been held to a minimum, while emphasis is laid upon the underlying principles of surgical practice which in turn devolve upon a thorough knowledge of physiology and pathology. New, relatively untried surgical procedures are omitted.

There is fresh material on emergency surgery, chest surgery, pre- and postoperative management, nutrition, parenteral medication, etc.

A criticism which might be levelled against such a uniformly excellent book is the quality of the illustrations. They are uncolored photographs or drawings, of small dimensions, and are not always reproduced with great clarity. Moreover, their total number is somewhat scanty, considering the scope of the text.

Textbook of Surgical Treatment. By C. F. W. Illingworth and contributors, Ed. 3, Baltimore, The Williams and Wilkins Company, 1947.

Few changes have been made since the last edition except to include new material on protein hydrolysates, the Rh factor and anticoagulants. In addition, new chapters on faciomaxillary injuries, plastic surgery, rehabilitation, and the use of penicillin in surgery have been included.

As is typical with most of the British texts, the book is impeccably written. The illustrations are not profuse, but adequate, and are clearly reproduced. The range of material is wide, including most of the topics that might reasonably be expected in a textbook of surgery.

It must be clearly recognized, however, that this is essentially an elementary work and will find its greatest sphere of usefulness as a teaching text for medical students. It is clear that British practice differs in many respects from that in this country. For example, the author favors the local application of sulfa-emulsions to burns, whereas such therapy has long been abandoned here. Another case in point is subtotal thyroidectomy. The technic described by the author would find small favor in most of our clinics.

Surgical Pathology. By William Boyd, Philadelphia, W. B. Saunders Company, 1947. For almost 25 years this worthy text has held almost undisputed reign as the standard reference book on surgical pathology for students and surgeons alike. Anyone familiar with the contents will readily understand why this is so, because in these pages teaching is first and foremost.

Using a writing style of great simplicity, Boyd has achieved a masterly, learned presentation. Some have objected to the dogmatic conclusions drawn by the author. While this might be out of place in a book of philosophy, for instance, it is most certainly appropriate in a didactic text. How

else can the beginner build a solid foundation upon which to house his knowledge? Inconclusive ideas, nebulous theories, or frank guesses are hardly calculated to instil certainty in the student's mind. The author is keenly aware of this, and herein lies the secret of Boyd's success as a teacher.

The subject matter has been only slightly altered since the 1942 edition except for the following additions: cardiac anomalies, Bittner's milk factor, the Papanicolaou technic, pinealoma, and miscellaneous conditions.

The drawings are good, the microphotographs are excellent, and the colored reproductions are little short of beautiful.

While this book can be recommended to anyone interested in the subject, it is particularly useful for the candidate undergoing preparation for examination in general surgery sponsored by the specialty boards.

Minor Surgery. By Frederick Christopher, Ed. 6, Philadelphia, W. B. Saunders Company, 1948. In the 20 years that have elapsed since Christopher first wrote Minor Surgery, a gradual but perceptible evolution has taken place in the contents of the succeeding editions until finally the material presented in the present edition may truly be spoken of as major surgery, despite the modest title and the absence of such formidable procedures as abdominoperineal resections.

The contents of Minor Surgery are already so well known to most of the surgical world that they require but little elucidation. Suffice it to say that the new material includes discussions on hemostatic agents, sympathetic blocks for phlebitis, intraarterial penicillin for gangrene of the extremities, refrigeration anesthesia, etc. Moreover, there has been extensive revision of such topics as chemotherapy, antibiotics, phlebothrombosis, thrombophlebitis, and anticoagulant therapy, as well as prophylactic vein ligation, burns, skin grafting, and other subjects too numerous to mention.

The author has dealt with his subject in a comprehensive manner, and has ably maintained the general excellence that prevailed in the earlier editions. The quality of the illustrations is disappointing, however, since they are too small, without color, and the radiographs have been poorly reproduced.

Minor Surgery. By R. J. McNeill Love, Ed. 3, London, H. K. Lewis & Co., Ltd., 1948. Most general practitioners or surgical internes who are recent graduates are tolerably familiar with the basic principles of general surgery. But they are frequently bewildered as to the optimal procedure when confronted with injuries of a so-called minor nature. McNeill Love's book offers precise, factual, and practical information, so that proper therapy can be promptly carried out.

That the surgical neophyte has found this book most acceptable is evidenced by the printing of the present edition, its third in eight years—ample proof of its popularity in England. The newcomer in surgical practice on this side of the water would be similarly well-advised to avail himself of the sound precepts of this well-known English teacher.

Emergency Surgery. By Hamilton Bailey, Ed. 6, Parts I & II, Bristol, John Wright & Sons, Ltd., 1948. This work has been a great favorite in England for 18 years, and has enjoyed no small measure of success in America.

Emergency Surgery is much more than its modest title implies. Actually it is a textbook of practical surgery. Into it has gone Bailey's tremendous surgical experience with meticulous attention to detail.

Part I deals with transfusions, shock, resuscitation, anesthesia, exploration of the abdomen. A discussion of various acute abdominal conditions, begun here, is carried over into Part II, which ends with a final section devoted to hernia. The material is up-to-date, has been extensively revised, and is presented in Bailey's inimitable literary style.

It is most regrettable that publication difficulties in England have necessitated the release of the work in five parts, three of which still await issue. If the remaining volumes live up to the standard set in the earlier parts, Emergency Surgery will hold a most valued spot in the bookshelf of anyone connected with the practice of surgery.

Essays on Historical Medicine. By Bernard J. Ficarra, New York, The Froben Press, Inc., 1948. Occasionally, there falls to the lot of the reviewer the rare opportunity of reading and enjoying an unusually good book. The handful of essays comprising this short work on medical history is just such a book, for it provided one and one-half hours of delightful, instructive and entertaining reading.

If for no other reason, this book should be read by every medical man because it at least provides a background against which an intelligent discussion of medical history may be carried on. Further, it may serve to stimulate interest in that fascinating subject and prompt the inquirer to delve into the more standard classics, such as Castiglioni or Garrison.

The subject matter includes a wide range of topics, running the gamut from American pioneers in surgery to famous historical autopsies. Regardless of what part of the book the reader's eyes chances upon, he will there find enough matter of sufficient interest to hold his attention until the end of the essay.

Victor Robinson Memorial Volume: Essays on History of Medicine, New York, The Froben Press, Inc., 1948. As the subtitle implies, this is a volume of short essays on various aspects of historical medicine. Originally intended as a birthday volume in honor of Dr. Victor Robinson's sixtieth anniversary, by virtue of one of life's grim ironies the book has instead become a memorial volume, for Robinson died prior to the publication of the work.

Under the senior editorship of Dr. S. R. Kagan, thirty-eight separate contributors have written fascinating short papers devoted to medical lore. The result is a treasury of engrossing literature.

The work is prefaced by letters of tribute from two eminent medical historians, Sigerist and Castiglioni, whom Robinson was largely instrumental in introducing to American medicine. The essayists proper have produced a work of uniformly high caliber.

The reader is referred to four obituaries which appear at the end of the volume, all written by close acquaintances, for a glimpse into the character of the man who, with the possible exception of Garrison, has done more than all others in making the medical profession in America conscious of the rich medical past.

The book has been issued in a limited edition, and should be an excellent addition to the libraries of those interested in historical medical classics.

Fielding H. Garrison: A Biography. By Solomon R. Kagan, Boston, Medico-Historical Press, 1948. Among contemporary medical historians, Kagan may perhaps be classed as one very conversant with the life and works of Garrison, and therefore eminently qualified to undertake the task of writing his biography. This small volume is, in effect, a sequel to the author's many earlier publications on Garrison.

The subject matter contains a wealth of information on Garrison's lineage, student days, army career, and final settling in Baltimore, up to the time of his death in 1935. The material is well-authenticated, with numerous references to actual letters, and to hitherto undisclosed information released by living relatives. An interesting evaluation of Garrison's work, by his friends, is included in the Appendix.

In reading this book it becomes clear that the biographer had a particularly difficult task since Garrison's life does not lend itself particularly to biography. Garrison led the secluded existence of a retiring scholar, utterly devoid of dash or glamour, and the true greatness of Garrison lay in his creative works.

Medical Writing. By Morris Fishbein, Ed. 2, Philadelphia, The Blakiston Company, 1948. The second edition of this vade mecum of medical authors is considerably changed from its predecessor. The present work is much larger, contains a considerable amount of new material, while the remaining portions are extensively revised. But the dominant theme remains unaltered: how to make medical writing more easy.

Such a book should rightly be written from the standpoint of the editor rather than the author, and for such a task no one is more eminently fitted than Dr. Fishbein, with his vast experience in this field. With tempered judgment and keen humor the author has analyzed the subject of preparing a medical manuscript. Moreover, he has done this in such a manner that he has converted a seemingly dry theme into a delightful presentation, as well as a most useful one. This book is truly indispensable for anyone embarking upon the sea of medical writing.

Handbook of Orthopedic Surgery. By A. R. Shands, Jr., Ed. 3, St. Louis, The C. V. Mosby Company, 1948.

Although some of the material has been revised, based on experience derived from World War II,

the book is essentially unchanged in the present edition. In accordance with the Undergraduate Instruction Committee of the American Orthopedic Association, the contents are divided into 24 chapters, each of which could be used as a basis for a one-hour instruction period. Most medical schools have been quick to seize upon this method in planning the orthopedic curriculum.

Such a concise text must inevitably have its shortcomings. Illustrations are scanty; operative technic is only briefly outlined; many items which strictly should be considered in an orthopedic light are omitted; and finally historical or other relevant data are not mentioned. But perhaps it would be unfair to expect more from this handbook, considering the strict limitations self-imposed by Shands, in striving to make this a teaching text for medical students. For this purpose it is unreservedly endorsed.

Fractures and Dislocations. By Edwin O. Geckeler, Ed. 4, Baltimore, The Williams & Wilkins Company, 1948. This handbook on acute fractures and dislocations has found a great deal of favor with both the undergraduate and the general practitioner, as attested to by the issue of this fourth edition since 1937. This is not surprising for Geckeler has specifically designed his work to meet the needs of the family physician, stressing the principles of early diagnosis, emergency treatment, transportation and closed reduction. The writing is clear, the instructions are precise, and the illustrations complement the text in an admirable manner.

It follows that in such a book as this there is no place for detailed accounts of operative technic, in keeping with the aims of the author. To further simplify the work, only one form of treatment is described for each condition. While it must be granted that the author's choice of treatment is usually a sound one, it is doubtful whether all orthopedic surgeons would be in agreement with the course of management advocated by Geckeler. One could hardly expect complete agreement of ideas in the treatment of fresh fractures and dislocations, and certainly the author's recommendations are well within the technical reach of the average physician. To this degree, Geckeler is supplying a long-felt need, that is, he is restoring the treatment of simple derangements of the skeletal system to the realm of the general practitioner where it rightly belongs.

Operative Gynecology. By Harry S. Crossen and Robert J. Crossen, Ed. 6, St. Louis, The C. V. Mosby Company, 1948. This text has been a well-known reference book to gynecologists and general surgeons for almost 35 years. It follows that there remains little more that can be said about it except that this sixth edition retains the general excellence that has prevailed in its predecessors.

In keeping with the current trend of cancer prevention, the authors stress the need for removal of foci subject to chronic irritation, such as cervicitis, kraurosis, leukoplakia, etc. They also make a strong plea for radical removal of uterus and ovary, when feasible, in performing surgery on women of the so-called cancer age who present symptoms. Similarly, they emphasize the value of curettage and radium insertion when surgery is contraindicated. In this connection, the authors have devoted detailed sections to the subject of radium treatment in cases of malignancy and nonmalignancy.

Diagnosis in Gynaecology. By James U. Ricci, Philadelphia, The Blakiston Company, 1948. This work might well be subtitled "A Handbook of Gynaecologic Diagnosis," for such it is and nothing more. All therapeutic discussions are rigorously avoided.

Preliminary chapters present anatomic and physiologic considerations of the female pelvic tract. The main matter of the text is a brief compendium of the assorted lesions affecting the various female genitalia classified on etiologic grounds and taken up in anatomic progression, starting with the vulvoperineum and ending with the parovarium.

It follows that there is some degree of repetition in the text. Thus, we meet with endometriosis in the sections on the vagina, uterus, tubes, ovaries, and finally genital ligaments, and so with other diseases. The reviewer cannot help but conclude that the subject matter could have been handled more logically if classified on a pathogenetic rather than an etiologic basis, the former being the system commonly employed in the larger treatises on gynecology.

There are no illustrations, and the presentation is dry.

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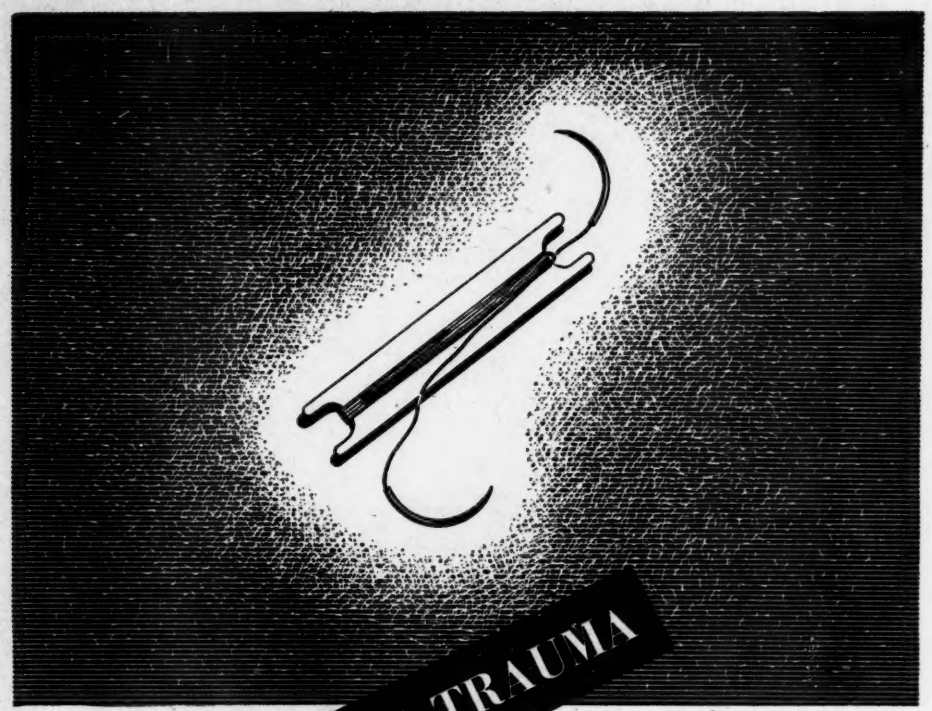

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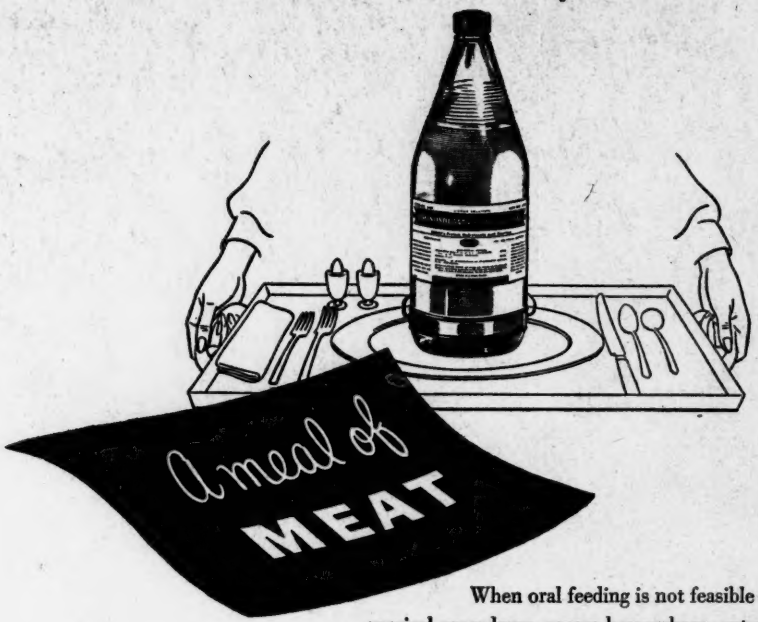


When oral feeding is not feasible following surgical procedures, severe hemorrhage, extensive burns or gastrointestinal disturbances, depend on the efficiency and safety of Abbott's protein hydrolysate, AMINOSOL 5% with Dextrose 5%.

consider the source . . .

AMINOSOL is a partial acid hydrolysate of blood fibrin —a recently published clinical experiment with AMINOSOL suggests that the peptides which occur in hydrolysates of blood fibrin are better utilized in the human body.[1] When AMINOSOL is administered as the total source of amino acids, 2000 cc. per day will maintain nitrogen balance in a normal 70 Kg. man.

. . . the method of sterilization

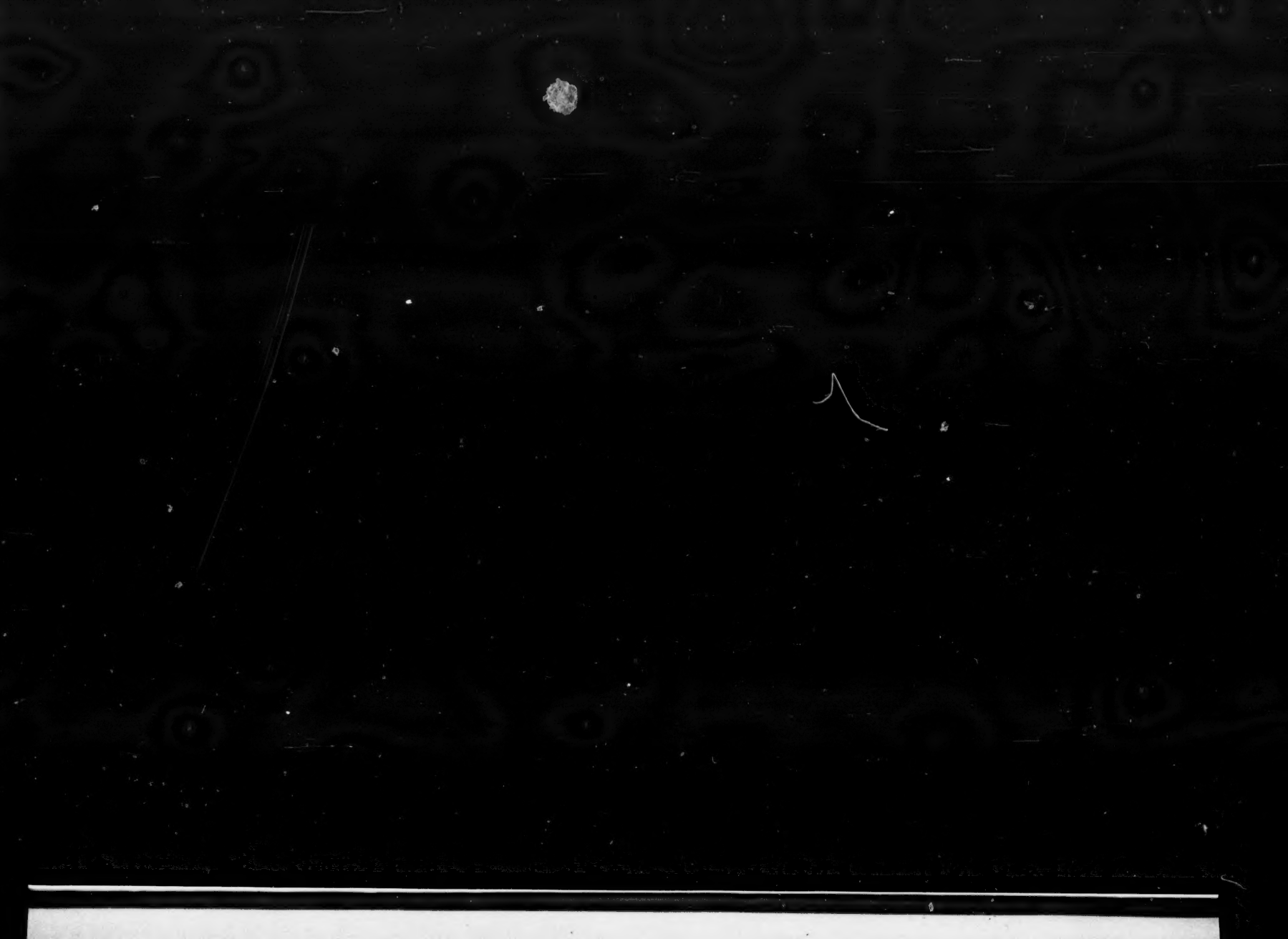
AMINOSOL is sterilized by autoclaving. In addition, it is biologically tested for its ability to promote growth and to maintain nitrogen balance, for absence of antigenicity and for absolute freedom from pyrogens. It is stable at room temperatures for two years or longer.

AMINOSOL is supplied in 500-cc. and 1000-cc. Abbott Intravenous Solution Containers, ready to use. Obtain added safety and convenience by using the sterile, disposable VENOPAK* equipment. ABBOTT LABORATORIES, North Chicago, Illinois.

*TRADE MARK FOR ABBOTT'S COMPLETELY DISPOSABLE VENOCLYSIS UNIT

Aminosol® 5%

WITH DEXTROSE 5%

Abbott's Modified Fibrin Hydrolysate 5% with Dextrose 5%

1. Christensen, H. N., Lynch, E. L., Decker, D. G., and Powers, J. H. (1947), The Conjugated, Non-Protein, Amino Acids of Plasma. W. A Difference in the Utilization of the Peptides of Hydrolysates of Fibrin and Casein, J. Clin. Invest., 26:849, September.